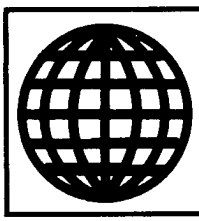
JPRS-JST-91-001
10 JANUARY 1991




# JPRS Report

# Science & Technology

## Japan
## 1989 S&T Agency Annual 33

# Science & Technology

## Japan

## 1989 S&T Agency Annual 33

*JPRS-JST-91-001* *10 January 1991*

CONTENTS

90FE0126 Tokyo KAGAKU GIJUTSUCHO NENPO in Japanese 30 Jan 90 pp 1-233
1989 Science and Technology Agency Annual 33 ..... 1
Part I. Policy Summary ..... 1
Chapter 1. Introduction ..... 1
Chapter 2. The General Promotion of S&T ..... 11
Chapter 3. Promoting Research with the Coordination Funds for Promoting Science and Technology ..... 30
Chapter 4. The International Frontier Research System ..... 35
Chapter 5. Promoting Creative S&T ..... 36
Chapter 6. Promoting Research Exchange ..... 43
Chapter 7. Regional S&T Promotion ..... 45
Chapter 8. S&T Information Activities Promotion ..... 46
Chapter 9. Maintaining Systems for Gathering, Storing and Supplying Genetic Resources ..... 48
Chapter 11. Development and Utilization of Atomic Energy ..... 49
Chapter 12. Intensification of Safety Measure Attendant upon Nuclear Power Development and Utilization ..... 64
Chapter 13. Promoting Space Development ..... 69
Chapter 14. Promoting Ocean Development ..... 72
Chapter 15. Promoting the Life Sciences ..... 74
Chapter 16. Promoting Substance/Materials-Related Science and Technology ..... 76
Chapter 17. Promoting Aeronautical Engineering Research and Development ..... 78
Chapter 18. Promoting Earth Science and Technology ..... 79
Chapter 19. Promoting Basic Research ..... 82
Chapter 20. Promoting New Technology Development and Technology Transfer ..... 83
Chapter 21. Promoting Comprehensive Resource Utilization Policies ..... 83
Chapter 23. Scientific and Technical Research Incentives ..... 84
Chapter 24. Surveys on General Internal and External Trends ..... 84
Part II. Outline of Advisory Organizations ..... 89
Chapter 1. Council for Science and Technology ..... 89
Chapter 2. Atomic Energy Commission ..... 91
Chapter 3. Nuclear Safety Commission ..... 93
Chapter 4. Radiation Council ..... 95
Chapter 5. Space Development Commission ..... 96
Chapter 6. Marine Development Council ..... 97
Chapter 7. Technical Fellows Council ..... 98
Chapter 8. Council for Aeronautics, Electronics and Other Advanced Technologies ..... 99
Chapter 9. Resources Research Council ..... 101
Part III. Summary of Affiliated Research Institutes ..... 102
Chapter 1. National Aerospace Laboratory ..... 102
Chapter 2. National Research Institute for Metals ..... 105
Chapter 3. National Institute of Radiological Sciences ..... 108
Chapter 4. National Research Center for Disaster Prevention ..... 115
Chapter 5. National Institute for Research in Inorganic Materials ..... 119
Chapter 6. National Resources Institute ..... 121
Chapter 7. National Institute for Science and Technology Policy ..... 122
Part IV. Summary of Semigovernmental Research Institutes ..... 125
Chapter 1. Japan Atomic Energy Research Institute ..... 125
Chapter 2. Japan Information Center for Science and Technology ..... 130
Chapter 3. Institute of Physical and Chemical Research ..... 135
Chapter 4. Research Development Corporation of Japan ..... 139
Chapter 5. Power Reactor and Nuclear Fuel Development Corporation ..... 142
Chapter 6. National Space Development Association ..... 146
Chapter 7. Japan Marine Science and Technology Center ..... 149
Appendices ..... 152

# 1989 Science and Technology Agency Annual 33

*90FE126A Tokyo KAGAKU GIJUTSUCHO NENPO in Japanese 30 Jan 90 pp 1-233*

[Excerpts] **Preface**

It can be said that science and technology plays an extremely important part in Japan's fulfillment of the role befitting its position in the demanding international context of today, and in Japan's formation of a new and richer 21st-century-oriented society. In particular, it is important that a country such as Japan—with few natural resources—contributes to the world by promoting S&T, and thereby achieving more abundant national strength, and by making the most its S&T results as common intellectual property of mankind.

The Science and Technology Agency is fine-tuning a plan that should answer these kinds of expectations, a plan with a long-range view that provides for the comprehensive and coordinated development of Japan's S&T. The agency is also promoting R&D in basic and creative fields that will sustain the next generation of technical innovation; in atomic power, space, marine, and earth S&T; in leading-edge fields such as the life sciences and new materials; and in fields such as disaster prevention that are closely connected with the people's lifestyle. Together with nurturing R&D, the agency is also endeavoring to energetically push forward various policies for S&T promotion that, for example, involve active international cooperation in every field.

During FY 1988, the agency's plans involved the promotion of abundantly creative S&T that focuses on fundamental research, in line with the "Outline of the Scientific and Technology Policy (a June 1986 Cabinet decision)." With concern for harmony with humanity and society and for international development, the agency worked towards the development of more positive policies. During July, the National Institute for Science and Technology Policy was established, and the agency made preparations for a system that more aggressively promotes S&T investigations and research. It was also a year during which Japan's S&T administration showed increased international growth: with the revisions to the Japan-U.S. S&T Cooperation Agreement and the conclusion of the Space Station Cooperation Agreement, and with the international acclaim received by the Human Frontier Science Program, a joint international program proposed by Japan that pushes forward basic research centered on elucidating the outstanding functions of living organisms.

Japan's S&T is entering into a new period of rapid progress and expansion as we near the 21st century. In the midst of this, the thinking of the Science and Technology Agency, as the core S&T administration of Japan both now and in the future, is to strive for further promotion of S&T that is based on mid- to long-range perspectives.

This 33rd annual report of the Science and Technology Agency is a compilation of S&T promotion policies that the agency implemented during FY 1988. We would be truly happy if, through this book, we could be honored with everyone's understanding of these policies.

December 1989

Administrative Vice-Minister for Science and Technology, Moriyuki Nakamura

## Part I. Policy Summary

### Chapter 1. Introduction

#### 1. General S&T Promotion

In these times of trying domestic and international situations, the advancement of science and technology provides not only a basis for improving the people's standard of living but also a means of contributing towards the support and growth of our country's international relations. Indeed, it is the foundation on which our country's development rests. S&T promotion will play a significant role in the society of the 21st century; it is essential to the emergence of a peaceful, prosperous society and to the stable growth of our society and the world as we approach the 21st century.

In view of the increasing intensification of man and society's relationship with S&T in recent years, what is sought after in the promotion of S&T is that which is harmonious with mankind and society.

With this kind of perspective, the government is establishing a basic doctrine for cultivating our country's S&T. In March 1986, the Cabinet established the Outline of the Scientific and Technology Policy, which clarified the importance of a national governmental policy for promoting S&T.

In 1988, the government strove to concretely formulate the basic guidelines of the Outline of the Scientific and Technology Policy, with the specific objective of fulfilling the duties appropriate for our country's present-day international position. In order to achieve this, they aimed for development that was much more progressive than just an S&T policy: the emphasis was on making a contribution to the world through innovations in creative, basic S&T—S&T that belongs to all of mankind. Policies were also developed for continuing existing government involvement in increasing equipment and facilities in the research environment; atomic power development and safety assurance; encouraging leading-edge R&D in space and marine development; disaster prevention, such as earthquake warning systems; life sciences; materials; S&T that is closely related to the people's living; and encouraging the distribution of S&T information.

More than ¥1.7158 trillion was set aside for S&T in the FY 1988 budget, a 3.2% increase over the previous year.

The primary duties of the Science and Technology Agency (STA) are to strive for S&T advancement and to promote S&T-related policies for the purpose of contributing to the people's lifestyle. In the agency's general accounts budget for FY 1988, the figure for yearly expenditures was ¥340.4 billion and the maximum amount appropriated by the Diet was ¥140.9 billion. In addition to planning and promoting basic S&T policies, the STA also oversees the general affairs of the Council for Science and Technology, the Atomic Energy Commission, the Nuclear Safety Commission, the Space Activities Commission, and other deliberative commissions which function as basic, comprehensive S&T policy formulators. The Science and Technology Agency is also in charge of the overall coordination of the S&T affairs of related government agencies, and regulating guidelines for estimating expenses related to research expenditures, grants, subsidies, and consignment fees for experimental research groups of related government agencies.

### 1) Standing Committees

#### (i) Council for Science and Technology

The Council for Science and Technology (CST) is our country's supreme deliberative organization for S&T affairs. The Prime Minister heads the CST, and the Minister for Finance, the Minister for Education, the Director-General of the Economic Planning Agency, the Minister for Science and Technology, and the chief of the Science Council of Japan make up the five other members. If the Prime Minister becomes involved with the overall regulation of one of the ministry's policies, he must first consult with CST members. The CST members then must either submit a report of their findings or, when circumstances dictate, express their opinions on the matter. As a part of the additional functional enhancements to the CST, the Coordination Funds for Promoting S&T, a system set up in 1981 for employing capital along the lines set forth by the council, was implemented to promote the critical research operations that are indispensable in the advancement of S&T. Further strengthening of the internal structure of the CST followed. In March 1983, a policy committee comprised of intellectuals from various fields was newly established within the CST so that mobile, flexible S&T policies would be developed. Then, starting in 1985, the Policy Committee of the Council for Science and Technology set up the "Preferential Guidelines for the Promotion of S&T." This report, which is updated every year, indicates the main directions to be taken in estimating budget demands for S&T-related matters within each of the government ministries and agencies.

In March 1989, the CST indicated the primary research subjects expected over the next ten years in the fields of information science and electronics, and the policies with which to support the research. The CST had been following the guidelines established in the Outline of the Scientific and Technology Policy that were decided upon by the Cabinet in March 1986, and in a report addressing the fifteenth question of the outline, "about the basic R&D plans for information and electronics science and technology," the CST indicated its expectations for these fields which have been undergoing rapid developments in recent years.

Also, the CST decided in September 1988 to "gather together information related to the urgent international problems surrounding S&T" in the Policy Committee's roundtable discussion on international problems.

#### (ii) Atomic Energy Commission

The Atomic Energy Commission, a deliberative commission within the Prime Minister's office, engages in planning, reviews, and decision-making in matters related to the research, development, and use of atomic energy (with the exception of nuclear safety regulation). The Minister for S&T is regarded as the chairman of the Atomic Energy Commission. In keeping a long-range perspective on atomic energy policy development for the 21st century while taking into account the changing foreign and domestic situations, the Atomic Energy Commission revised the Long-Term Nuclear Power Development and Utilization Plan in June 1987. The commission's other activities include conducting review meetings in a variety of specialized departments and supporting the development and utilization of atomic energy.

#### (iii) Nuclear Safety Commission

The Nuclear Safety Commission, a deliberative commission within the Prime Minister's office, engages in the planning, reviews, and decision-making involved in ensuring the safety of atomic energy research, development, and utilization. This commission receives inquiries from various administrative agencies and conducts safety inspections in nuclear power plants. The Nuclear Safety Commission puts forth several kinds of guidelines and standards so that when it comes time to implement a safety system in a nuclear power plant it can uniformly evaluate the safety systems for each administrative agency, basing its judgements on standards that are objective and rational. The Nuclear Safety Commission also accepts accident and trouble reports from nuclear power plants as the occasion demands and conducts deliberations.

#### (iv) Space Activities Commission

The Space Activities Commission, a deliberative commission within the Prime Minister's office, engages in planning, reviews, and decision-making in matters related to space development. The Minister for S&T is regarded as the chairman of the Space Activities Commission. On 15 March 1989, this commission conducted a review of the Space Development Plan, which was decided upon on 11 March 1988, basing its reconsiderations on the Outline for Space Development Policy, and submitted an advisory report to the Prime Minister. The Space Activities Commission also deliberates on reviews

of the Outline for Space Development Policy that are conducted in long-term policy departments.

2) As a part of the overall coordination of S&T affairs in related government agencies, the Science and Technology Agency regulates, on a yearly basis, the lines along which S&T-related expenses, grants, etc. are estimated for experimental research organizations of related government agencies. The objective of this system for estimation policy control is to effectively and efficiently promote R&D in a nation-wide coordinated manner. In more concrete terms, the STA is striving to effectively promote S&T by rounding out ordinary research, intensifying cooperation between related agencies and institutions, and maintaining the research base, together with defining which research fields should be promoted as nationally significant, avoiding overlaps and omissions in inter-related research, continuing comprehensive encouragement, and securing the necessary funding. In 1988, the agency began coordinating the experimental research that is conducted on an ongoing basis by governmental agencies. In addition, the agency took charge of estimating the S&T expenditures for FY 1989 and coordinated the estimation policies, basing their guidelines on the government's administrative policies and the reports and opinions of other advisory groups such as the Council for Science and Technology. 3) Securing sufficient capital as well as superior talent is essential to the promotion of R&D. With this in mind, the Science and Technology Agency has been gathering suggestions from related governmental agencies about ways to improve the treatment of civil service researchers and has been presenting these demands every year to the National Personnel Authority. The agency is also taking steps to screen both foreign and national exchange students and to provide for their expenses.

4) In looking at the importance attached to the role of industrial, academic, and governmental experimental research agencies in the promotion of S&T in our country, the Science and Technology Agency sponsored the FY 1988 National Research Institute Conference on Promoting Exchange on 7 December 1988. The aims of this conference, which involved lectures and panel discussions, were to strengthen cooperation between industrial, academic, and governmental experimental research agencies; to promote the exchange of information about the management and operations of these agencies; to bring about mutual understanding of purpose between government bureaus and the agencies in charge of research; and to assist in the future development of vigorous research activity and governmental S&T policies.

5) In recent years R&D has become increasingly more advanced and complex, and its limits and areas of overlap have been expanding. To encourage S&T in such an age, the aggressive promotion of research exchange is vitally important. For this reason, the Research Exchange Promotion Law, estabished on 20 May 1986, was put into effect on 19 November 1986. The law incorporates measures for improving the legal bottlenecks that occur in the harmonious promotion of research exchange between private enterprises and government research agencies or universities. Also, the Cabinet decision entitled "About Basic Policies in Connection with the Practical Application of Systems To Promote Research Exchange Between Industry, Academia, Government, and Foreign Countries" was a step taken on 31 March 1988 to provide policy guidelines on which specific areas to tackle in the practical application of research exchange systems.

### 2. Encouraging Research with the Coordination Funds for Promoting S&T

1) To build the scientific and technological foundation of our country while keeping in mind stable economic growth and an improved standard of living for the people, we must concentrate all of our energy on promoting S&T that is primarily independent technological development that is rich in creativity. And, in keeping up with the increasingly more advanced, more complex state of R&D in recent years, we must strive to make R&D more efficient, such as by strengthening the coordinated cooperation between industry, academia, and government. The Council for Science and Technology (CST), the supreme deliberative agency for our country's S&T policies, was established to deal with these tasks. The CST conducts overall coordination with high-level judgement and an expansive field of vision. The importance of its ever strengthening leadership role has been pointed out in many different areas.

As a part of the strengthening of the CST's function as an overall coordinator, the Science and Technology Agency gave the CST control of the Coordination Funds for Promoting S&T in FY 1981, doing away with the existing Coordination Funds for Promoting Special Research. In attempts at further strengthening and expansion, ¥9.2 billion was allocated for the Coordination Funds for Promoting S&T in the budget for FY 1988, a 9.5% increase from the previous year.

In striving for the smooth management of these funds, the CST established the "Basic Policy on Utilization of the Funds for Promoting S&T" on 9 March 1981, and later revised it on 27 November 1984. This policy served as the basis for decisions about the actual management of the funds, decisions which were made after related agencies and intellectuals were consulted in policy committee meetings.

In the Basic Policy on Utilization of the Funds for Promoting S&T, the following points are meant to serve as the guiding basis for the use of the funds.

1) The promotion of leading-edge and basic research
2) The promotion of R&D requiring cooperation between a number of research institutes
3) Strengthening the coordinated cooperation between industry, academia, and government
4) The promotion of international joint research
5) Flexibility to respond to an emergency situation with the appropriate research
6) Implementing research assessments and conducting surveys and analyses on R&D

The following keypoints provided the basis on which the actual management of the Coordination Funds was carried out in FY 1988:

1) S&T Promotion that gives continued attention to fields such as earth S&T, with emphasis on substance and materials S&T and the life sciences
2) Applying powerful R&D to meet national and social needs
3) The active promotion of international joint research
4) Promoting basic research in the national research institutes with the goal of germinating the seeds of technological reform that emphasizes researchers' creativity
5) Investigating methods for promoting R&D, and adequately conducting the necessary surveys and analyses for selecting research topics

### 3. Promoting Creative, Fundamental Research

#### 1) Promoting International Frontier Research

In order for our country to develop S&T that is rich in creativity as we head into the 21st century while also contributing to international society, we must perfect the fundamental research that nourishes the soil in which the technology of the 21st century will grow. In response to this kind of demand, the International Frontier Research System was inaugurated in October 1986 within the Institute for Physical and Chemical Research (RIKEN). The purpose of the International Frontier Research System is to acquire the new knowledge that will become the basis of technological reform in the 21st century. The system, which aims to recruit excellent researchers from industry, academia, the government, and abroad to conduct leading-edge basic research, is currently promoting ten research teams involved in "Biological Homeostasis," "Frontier Materials," and "Thought Function" research. Four of these teams are led by a foreigner.

#### 2) Expanding the Creative S&T Promotion System

The Creative S&T Promotion System was launched in 1981 to conduct investigative research that would generate the seeds of creative, progressive technology. In this system, researchers from industry, academia, the government, and abroad are recruited to work under leaders in whom leadership and knowledge are superbly synthesized; it is a system where the typical organizational walls can be overcome in order to achieve creative research activity. The system, which is being promoted by the Research Development Corp., was expanded in FY 1988 to include three new projects (quantum wave, polar re-orientation, and plant information substances).

### 4. Maintaining the R&D Base

#### 1) Encouraging Research Exchange

In recent years, R&D is becoming increasingly more advanced and complex, and its limits and areas of overlap are continually expanding. Consequently, to promote creative technology now and in the future, it is vitally important to actively encourage research exchange that overcomes organizational barriers, research exchange, both physical and social, between different fields, and the organizational structures which enable such exchange, and to effectively and efficiently utilize limited research resources.

With this kind of view in mind, the Research Exchange Promotion Law was put into effect in November 1986 and the Cabinet decided upon the "Basic Policy on the Operation of Systems Connected with the Promotion of Research Exchange among Industry, Universities, the Government and Foreign Countries" in March 1987.

In FY 1988, in addition to endeavoring to promote the application of the Research Exchange Promotion Law, a research meeting was also held to investigate, from a specialist's viewpoint, the problems within the system that had been encountered during the promotion of research exchange, and ways to acceptably, harmoniously encourage research exchange.

Tsukuba Science City, a jointly used institution, has become the place for scientists to come into face-to-face contact with each other in a research situation. The Science and Technology Agency is not only expanding the Research Exchange Center operations there, which provides S&T information, but has also enhanced its services for auxiliary research organizations.

At the same time, the Tsukuba Science City Research Organizations Coordinating Council has been holding conferences to promote comprehensive research exchange activity such that research activities at Tsukuba Science City, which encompass an expansive area with many branches, can be conducted in an efficient manner that continually sustains mutually coordinated cooperation.

#### 2) Promoting Local Science and Technology

Nowadays, the advancement of R&D functions is accelerating, the promotion of local areas is gaining speed, and even in CST Report No 11 (a Cabinet decision in November 1984) and the fourth Comprehensive National Development Plan (a Cabinet decision in June 1987), the strengthening of local R&D functions is considered to be a strategic topic in the activation of regional areas.

More efficient and effective R&D activity must be stepped up for the enthusiastic local industrial, academic, and governmental research institutions, which added to S&T promotion through mid-level R&D organizations.

For those reasons, the Local Research Exchange Promotion Project was undertaken in 1988 to actively encourage the promotion of S&T in local areas.

### 3) Facilitating the Distribution of S&T Information

In view of the need in our country's technological development for facilitated publishing of S&T information in such a way that it can be effectively utilized, the plan for the National Distribution System for S&T Information (NIST) has been promoted. In FY 1988, the "Knowledge-Based Chemical Substance Design System Research" program was continued from the previous year with support from the Coordination Funds for Promoting S&T.

Also, as basic tasks in facilitating the distribution of S&T information, activities in format standardization and fact-database surveys have been pursued.

The Japan Information Center for Science and Technology (JICST) has overseen the expansion of its document, fact and English databases; the development of information processing technology for maintaining an online information search service, a preliminary information reproduction service, the JOIS-III system, and a machine translation system which meets the standards for practical use; and regional information services. The JICST, having promoted the international S&T information network, STN International, is also participating in the exchange of S&T information on an international level and is actively encouraging cooperation with foreign countries.

### 4) Maintaining Systems for Gathering, Storing and Supplying Genetic Resources

Because biological materials of guaranteed quality are needed in life sciences research, maintaining systems through which genetic resources can be collected, preserved, and supplied is important.

Since FY 1986, the Institute for Physical and Chemical Research (RIKEN) has been involved on a full-scale basis in the "Preservation of Microbiological Strains Project," the subject of which is microbiological materials at the individual level. The institute has also been involved with the "Cellular and Genetic Storage Gene Bank Project," which it began in FY 1987 with the objective of collecting, preserving, and supplying cellular and genetic materials and related information.

Hypothesizing that information about the storage of genetic resources will need to be published, the RIKEN also conducted investigations into a genetic resources database that focuses on plants.

## 5. Promoting International S&T Cooperation

In recent years, the problems of natural resources, energy, the environment, and populations have come to the forefront throughout the world, and the thought of each country trying to solve these problems on its own is a distressing topic. The need for international cooperation is suddenly accelerating, and the importance of international cooperation in scientific and technological fields is especially crucial.

In the midst of these kinds of circumstances, our nation, which must work towards building an S&T base that continues to strive for harmony with international society, is aggressively promoting international cooperation with industrialized countries, developing countries, and international organizations.

At the economic summit of the major industrialized countries held in Versailles in June 1982, our country announced the results of investigations into the yet to be implemented Human Frontier Program. The economic statement issued at that summit meeting included a passage expressing the expectations of other countries about the program. Following the reception of that statement, the program contents were decided upon in an international meeting held between scientists, and a detailed investigation was conducted.

With respect to space development, in both the 30th committee meeting of the UN Conference on the Peaceful Uses of Outer Space, held in June 1987, and in the February 1988 meeting of that group's S&T subcommittee, subjects such as the technical aspects of remote sensing and atomic-powered satellites were reviewed. In the 27th Meeting of the Legal Subcommittee held in March and April 1988, the physical properties and technical attributes of geostationary orbits, and the problems of atomic-powered satellites were also reviewed.

In connection with atomic energy, the expansion of international cooperation is steadily progressing due to the efforts of the International Atomic Energy Agency (IAEA), the NEA, and cooperation with American and European industrialized countries and nearby Asian developing countries.

Also, in view of the international obligation to devise measures for safeguarding nuclear materials, the signing of the "Nuclear Materials Security Agreement," which became effective in February 1987, was approved by the Diet in May 1988, and the agreement was signed in October 1988. Regarding the establishment of a framework for a long-term, comprehensive solution to the reprocessing problem, which had been pending between Japan and the US since the reprocessing negotiations in 1987, the "Agreement between the Japanese and US Governments to Cooperate in Matters Related to the Peaceful Use of Nuclear Energy" was signed in November 1987 and became effective in July 1988.

More vigorous cooperative activity is unfolding with, in addition to these two-nation cooperative agreements, the revision of the S&T agreement with the US (June 1988) and the concluding of a renewed S&T cooperative agreement with Italy (October 1988). Also, vigorous cooperation based on past S&T agreements with France, West Germany, Canada, Australia, and China is being promoted.

Cooperation involving international organizations such as the UN, OECD, and the Asia Scientific Cooperation Alliance (ASCA) is also being carried out.

### 6. Promoting the Development and Utilization of Nuclear Power

The safe, reliable guarantee of energy is a necessary and vital theme in socioeconomic development and in improving the people's standard of living. Although the domestic and foreign energy situation has been gradually easing in recent years, mid-range and long-range forecasts point to a tightening oil demand. So, for our country, which ranks high in terms of the degree of its dependence on oil when compared with other major industrialized countries, reducing our reliance on oil is crucial. For this reason, nuclear energy, which is superior in terms of supply stability and its economic and environmental impact, is viewed as being the main substitute for petroleum energy. Limiting its use to peaceful objectives, we must continue to promote the development and utilization of nuclear energy with its careful safeguarding as an important prerequisite.

Nuclear energy development in 1988 is described below.

#### 1) Overall Strengthening of Safety Policies

For doubly-insured safety and protection in connection with the development and use of nuclear energy, strenuous efforts have been made in the strict application of the Nuclear Reactor Regulation Law and the Radiation Sickness Prevention Law. In addition, the continuous intensification of research in nuclear facilities safety, research in environmental radiation safety, reducing the discharge of radioactive materials, radioactive waste processing and disposal R&D, and research in the prevention of radiation sickness have been encouraged. Furthermore, together with an environmental radioactivity survey to determine the equivalent dosage of radiation that the people are being exposed to, efforts are also being made to achieve higher perfection in disaster policies for areas in the vicinity of nuclear energy facilities. Also, at the time of the signing of the agreement about safeguarding nuclear materials, services related to the enforcement of the Nuclear Reactor Regulation Law and other laws were undertaken, thereby achieving yet greater improvements in the protection of nuclear materials. Moreover, domestic security measures were put into effect.

#### 2) Establishing the Nuclear Fuel Cycle

Establishing an independent nuclear fuel cycle that provides a stable supply of nuclear fuel and that effectively utilizes uranium is a policy matter of ever increasing importance. With regard to uranium prospecting, the Power Reactor and Nuclear Fuel Development Corp. (PNC) is, on its own or in cooperation with organizations abroad, investigating ore deposits in Australia, Canada, and Africa, and is promoting continued surveys and prospecting activities abroad.

The development of uranium enrichment technology that is based on the centrifugal separation method has been promoted as a national project by PNC and other groups. The PNC's pilot plant has been in full-scale operation since March 1982, and its prototype plant has been in the first phase of operations since March 1988. The PNC is also making progress in the research and development of laser uranium enrichment technology. With respect to reprocessing of spent fuel, the PNC is continuing operations of its reprocessing facility together with R&D efforts to improve reprocessing technology.

In the area of radioactive waste processing and disposal, development of vitrification processing for high-level radioactive wastes, R&D in geological disposal, and experimental research for assessing the safety of land disposal for low-level radioactive wastes have been underway.

In terms of the industrialization of the nuclear fuel cycle, the Japan Nuclear Fuel Service Co. and the Japan Nuclear Fuel Industries Co. are making progress in the construction plans for reprocessing plants in Rokkasho Village, Aomori Prefecture. These plants will handle both uranium enrichment as well as low-level radioactive waste processing. The Japan Nuclear Fuel Industries Co. began construction of its uranium enrichment plant in October 1988, and in April 1988 it applied for permission to operate a low-level radioactive waste processing plant. In March 1989, the Japan Nuclear Fuel Service Co. also applied for authorization as a reprocessing enterprise and for permission to operate a low-level radioactive waste processing plant.

#### 3) Development of Advanced-type Reactors

With 1992 as the deadline, construction of Monju, a prototype fast breeder reactor plant, is progressing together with the R&D needed for a demonstration reactor. Operational experience with advanced-type conversion reactors has been acquired from the operations of the Fugen prototype reactor, and the PNC and the Electric Power Development Co. have made progress in the R&D needed for the construction of a demonstration reactor.

Also, the Electric Power Development Co. made progress in environmental studies and in the basic design of the demonstration reactor that it has to build in Oma Town, Aomori Prefecture.

#### 4) Fusion R&D

Nuclear fusion is expected to provide an important source of energy for mankind in the future. In September 1987, the Japan Atomic Energy Research Institute (JAERI) achieved its goal of attaining critical plasma conditions with its JT-60 critical plasma test device. Since then, JAERI has been working on improving the functions of the JT-60 in order to facilitate R&D for the next, larger critical plasma test device. The National Research Institute for Metals is also making headway in research connected with nuclear fusion materials. In the

international arena on the other hand, a rough plan for the joint design of the International Thermonuclear Fusion Experimental Reactor (ITER) was started in April 1988. Japan, the EC, the US, and the Soviet Union are involved in the ITER project, which is under the auspices of the IAEA.

**5) Radiation Utilization**

The utilization of radiation, as an important support of the peaceful use of atomic energy that runs parallel to nuclear power generation, is applied in a wide variety of fields such as medicine, industry, and agriculture, and contributes significantly to the well-being of the people.

The use of radiation in the field of medical service is especially important. The National Institute of Radiological Sciences continues to use proton and neutron beams in treating patients, and, in FY 1988, it started manufacturing a heavy particle beam device for use in cancer treatment that is highly effective.

For industrial and agricultural fields, research in the advanced use of radiation and in the production and use of radioisotopes is being conducted at JAERI.

JAERI is also in the process of building a facility that uses ion beams for research in advanced radiation utilization.

**6) Nuclear Vessel R&D**

In addition to the construction of a new on-shore facility at the Port of Sekinehama, JAERI is not only busy with inspecting the ship's reactor container cover release and other equipment preparations for a trial voyage, but has also set up research for improving reactors that will be used aboard marine vessels.

**7) Testing and Research in High-Temperature Engineering**

Our country's high-temperature gas reactor R&D, which is conducted primarily by JAERI, has been steadily progressing. JAERI bases its R&D in high-temperature gas reactor component technology on tests such as demonstrating the heat transfer and flow from very hot helium to various structures, limit tests, and fuel component irradiation tests.

In the current energy situation, trends in the demand for the utilization of thermonuclear processes indicate the change in society's attitude towards high-temperature gas reactors. With this in mind, the Atomic Energy Commission established the Special Committee on the High-Temperature Gas Reactor R&D Program in March 1986, conducted studies to investigate directions in which to proceed, and released a final report in December 1986. In the New Long-Term Plan for the Development and Use of Nuclear Power, the report proposes a review of the construction plans for an experimental reactor, which until then was the first step taken in the practical utilization of high-temperature gas reactors; construction of a reactor for high-temperature engineering test research, which would allow efficiency and diversity in test research; establishment and upgrading of the fundamental technology for high-temperature gas reactors; and the promotion of leading-edge basic research in high-temperature engineering.

Additionally, on 10 February 1989, JAERI's application for permission to establish a high-temperature engineering test reactor was brought before the Prime Minister, and the Prime Minister's office began safety investigations.

**8) Promoting the Development of Basic Technology**

A great deal of importance is being attached to those fields of atomic energy technology development that are creative and innovative. JAERI, PNC, RIKEN and the National Test Research Agency, among others, aiming to build a system of nuclear energy technology that is seen as being necessary in the 21st century, are implementing the development of basic nuclear energy technology, in four technical areas. For the time being, these areas are materials, artificial intelligence, lasers for use in nuclear power, and radiation risk assessment and reduction.

In FY 1988, 42 themes were implemented by 18 agencies. Furthermore, starting in FY 1989, "Comprehensive Research in Basic Atomic Energy Technology," a necessary and important theme which takes into account the total potential of each research agency involved in basic research, was established. Industry, academia, and the government have been actively engaged in promoting this theme.

**9) International Cooperation**

Positive progress is being made in international exchange amongst scientists and engineers, and the sharing of information and materials. Also, starting with the countries that signed the Atomic Energy Cooperation Agreement and continuing on down with cooperative agreements with international agencies such as the IAEA and the OECD/NEA, Japan is involved in close cooperation with many other countries.

**7. Promoting Space Development**

Through the media of artifical satellite communications and broadcasting, earth and meteorological observations, and scientific observations, space development contributes to industrial economic development, the advancement of science, and the improvement of the people's standard of living. In FY 1988, the National Space Development Agency (NASDA) aggressively promoted space activities based on the Space Development Plan, a plan decided upon by the Space Activities Commission.

In line with the main ideas presented in the "Outline of Space Development Policy," the Space Activities Commission conducted a review of the "Space Development Plan" in March 1989. The commission also deliberated on expenditure estimates for FY 1989 space activities,

safety policies related to the launching of rockets and satellites in FY 1988, evaluations of results from rocket and satellite launches in FY 1988, and, with a long-range viewpoint, the basic subjects concerning the ways our country's space development should progress.

The following describes the state of each field of space development.

**1) Artificial Satellites**

In September 1988, the communications satellite "Sakura No 3-b" was launched, and development work continued on the No 4 geostationary meteorological satellite, the No 3 broadcast satellite, the No 1 earth resource satellite, and the VI-type engineering test satellite (ETS-VI), all of which are scheduled to be launched some time after FY 1989. Also, development of the No 1-b marine observation satellite and the No 5 geostationary meteorological satellite, and R&D for the earth observation platform technology satellite commenced.

**2) Rockets**

Development of an H-I rocket, capable of launching 550-kg geostationary satellites, is progressing, and an H-I rocket (stage 3) was successfully launched in September 1988. Also, to deal with the demand in the 1990's for large-type satellites, development of the H-II rocket, capable of launching 2-ton-class geostationary satellites, was pushed forward.

**3) Space Experimentation and the Space Station**

With the goal of putting into operation by FY 1991 the First Material Processing Test (FMPT), an experiment in which Japanese scientists and engineers will board the space shuttle and, taking advantage of the special features of the outer space environment, will conduct material tests, test systems are being developed and scientists and engineers are being trained.

There is also an international joint space station program involving Japan, the US, Europe, and Canada. In September 1988, these countries signed the Space Station Cooperative Agreement, which established the cooperative framework for post-development stages of the program, and the job of preliminary planning was conducted by the National Space Development Agency (NASDA).

**4) Other Activities**

International cooperatation has been promoted through participation in the UN Committee for the Peaceful Use of Outer Space, and by holding meetings for the Japan-US Standing Committee Staff Liaison Group (SSLG), the Japan-ESA Administrative Coucil and other groups involved in fields related to space development.

**8. Promoting Marine Development**

In striving for the continued evolution of mankind, development of the oceans, which possess an abundance of natural resources and energy, is important. Furthermore, the oceans exert a powerful influence on the global environment, and elucidating those realities is becoming an urgent need.

Currently, based on this kind of situation, the STA is assuming three responsibilities in connection with marine development.

The first responsibility is to manage the Council for Ocean Development. In response to the inquiry entitled "Regarding Long-Term Perspectives on Marine Development: Basic Ideas and Promotional Policies," the Council for Ocean Development submitted its first reply to the Prime Minister in August 1979, and its second reply in January 1980. Afterwards, in view of the 1990 target date for measures proposed in the two replies and the fact that the domestic and international state of affairs surrounding marine development has changed drastically since the time of the replies, the Prime Minister passed the inquiry back to the Council for Ocean Development on 3 February 1989. The council is now deliberating on a reply.

The second responsibility of the STA in connection with marine development is the comprehensive promotion of marine S&T for the entire government. The STA handles the comprehensive coordination of the government's marine S&T and, to comprehensively and in a planned fashion advance marine development of related agencies in the Liaison Council for Marine Development in Related Ministeries, which is made up of Secretariat directors, the STA also draws up the plans and policies every year for the "Program for Promoting Marine Development."

The STA's third responsibility is to promote investigative research and R&D in marine S&T activities within the STA. The "Shinkai 6500" development is one of the comprehensive, pioneering common R&D activities conducted primarily by the Marine S&T Center with the cooperation, as the needs arises, from related ministries and organizations. Other such activities include the following seven comprehensive marine S&T projects promoted by the STA.

1) Deep sea diving survey vessel R&D
2) Diving operations technology R&D
3) Investigative research in the development and utilization of the Japanese Current
4) Marine utilization R&D
5) Marine observation technology R&D
6) Marine remote exploration technology R&D
7) Cooperative local R&D

In addition to these projects, the Marine S&T Center, our country's core organization for marine S&T development, is also engaged in operations of a high-pressure experimental tank facility, diver training programs, and the collection and publishing of marine information.

### 9. Promoting Earth Science and Technology

In recent years, thanks to remarkable developments in leading-edge technology such as deep sea survey vessels and remote sensing, knowledge about large-scale atmospheric and oceanic fluctuations, and knowledge about the influence of mankind's activity on the environment has increased dramatically. There is also a close connection between these phenomena and mankind's social activity, and there has been growing social interest in understanding these phenomena more deeply. Accordingly, the promotion of earth S&T is expected to provide some solutions for disaster prevention and environmental problems, and to contribute to global forecasting. And, from the perspective of the common benefits that can be reaped for all of us earthdwelling humans, the results obtained from earth S&T will be exceptionally important.

For these reasons, the STA has been promoting research in disaster prevention technology, research in deep sea surveying, and satellite-based remote sensing technology R&D in the National Research Center for Disaster Prevention, the Marine S&T Center, and the Space Development Corp.

Also, as investigative research that focuses on various global-scale phenomena, efforts such as "Research pertaining to the Asia Monsoon System" will commence starting in FY 1989, supported by the Special Investigative Research Funds for Earth S&T. In FY 1988, projects such as the "International Joint Research in Climactic Fluctuations and Pacific Atmospheric and Oceanic Fluctuations" was promoted with support from the Coordination Funds for Promoting S&T and cooperation from related ministries and universities.

### 10. Promoting Substance and Materials-Related S&T

Substance and materials-related S&T not only contributes to the evolution of an economic society, but also provides a foundation for advancements in other S&T fields. Substance and materials-related S&T is expected to continue to fulfill its role as the driving force behind technological progress both now and in the future. Especially in recent years, a fresh, new evolution is being witnessed in, for example, the growing possibility of creating radically new substances and materials using atomic and molecular-level control techniques. The promotion of substance and materials-related S&T is becoming a vitally important topic.

In addressing these topics, the reply to the Council for Science and Technology Inquiry No 11 (November 1984) and the Outline of the Scientific and Technology Policy (a March 1986 Cabinet decision) point out the importance of substance and materials-related S&T—in activating the economy and in providing the basic, pioneering S&T that enables new development—and treat the field as one which should be aggressively promoted.

Basing its recommendations on these guidelines, the Council for Science and Technology submitted its reply to the 14th inquiry, "Regarding the Basic Plan for R&D in connection with Substance and Materials-Related S&T," in August 1987, indicating its schemes for efficiently and comprehensively promoting R&D in substance and materials-related S&T.

Ever since the discovery of superconducting oxides in 1985, an opportunity was seen, and expectations for the practical utilization of superconductors were suddenly heightened. In roundtable discussions on superconductors during November 1987, the Policy Subcommittee of the Council for Science and Technology put together a report entitled "Regarding Basic Promotion Policies for Superconductor R&D."

In September 1984, the Council for Aeronautics, Electronics and Other Advanced Technologies submitted its reply to the seventh inquiry entitled "Regarding the Promotion of Comprehensive R&D in New Materials Creation Based on Material Design Theory," indicating the comprehensive promotional policies on the development of new materials by material design methods. And, in March 1986, the same council submitted its reply to the ninth inquiry entitled "Regarding Priority Issues and Promotional Policies in Connection with Improving Measurement and Control Technology for New Material R&D," indicating the general promotional policies on the control technology, such as beam, limit, and measurement technology, that is the important basic technology for new materials R&D.

Furthermore, scientists are making the most of methods that are based on new concepts such as the so-called intelligent materials, and importance is being placed on efforts to create new materials that are capable of radically new functions. Consequently, the Prime Minister came forth with the inquiry entitled "Regarding the Promotion of Comprehensive R&D in the Creation of New Substances and Materials That Have the Capacity to Exhibit Functions and Respond Intelligently to Environmental Conditions" (July 1987, Inquiry No 13), and from now on investigations are being conducted into those promotional policies.

Basing its strategies on these developments, the STA is promoting basic fields that are common throughout substance and materials S&T. Namely, materials R&D for applications in ultralow temperature equipment, R&D in various kinds of metals, research in biofunctional ceramics, research in the creation of inorganic substances, and other efforts, are being carried out at the National Research Institute of Metals and the National Institute for Research in Inorganic Materials. Also, the Research Development Corp. is engaged in R&D activity concerning "solid state surfaces" and "chemical structures" under the Creative S&T Promotion System.

Furthermore, the following research projects were undertaken with support from the Coordination Funds for Promoting S&T: Research in New Beam-Based Analysis

and Evaluation Technology for High-Performance Functional Materials; Research in Connection with the Development of Ultrahigh Temperature Generation, Measurement, and Utilization Technology; Research in Connection with the Development of Technology for Evaluating the Reliability of Structural Materials; Research in Basic Technology for the Creation of New Materials Using Hybrid Structure Design Technology; Research in Ultrahigh Vacuum Generation, Measurement, and Utilization Technology.

In addition to these, RIKEN, JAERI, and other institutions are also conducting research in substance and materials-related S&T.

Regarding superconducting oxide R&D, special corporations and national research organizations such as the National Research Institute of Metals, the National Institute for Research in Inorganic Materials, RIKEN, and JAERI—groups with R&D potential—started the "Superconducting Materials Research Multicore Project" in FY 1988, a project which promotes flexible joint research participation at home and abroad, researcher exchange, and information exchange.

**Promoting the Life Sciences**

The life sciences cover a broad range of S&T fields, from basic biology to health and medicine; agriculture, forestry, and fisheries; mining; and environmental conservation.

As a comprehensive promotional policy for these life sciences, the CST produced the report entitled "Opinions on the Promotion of the Life Sciences" (August 1983) together with submitting its reply (1984) to Inquiry No 10, "Regarding the Basic Plans for Promoting Pioneering and Fundamental Technology for the Life Sciences." In addition to these, other reports have been made: Opinions on Basic Policies for Cancer Research (July 1984), Opinions on Basic Policies for S&T Promotion in Coping with an Aged Society (May 1986), Opinions on Basic Policies for Promotiong R&D in Neurological S&T (August 1987), Opinions on Basic Policies for Promotiong R&D in Immunology S&T (August 1988).

Regarding the analysis of human genomes, its significance and promotional policies, the Council for Aeronautics, Electronics and Other Advanced Technologies submitted a report (June 1988) in reply to Inquiry No 12, "Regarding the Promotion of Comprehensive R&D in Human Genetic Analysis."

The STA is putting into effect policies that are based on both the aforementioned reports and the Prime Minister's "Basic R&D Plans for Pioneering and Fundamental Technologies" (August 1984), and, in making the best use of the Coordination Funds for Promoting S&T, the STA is currently promoting a research project involving nine subjects which include "Research in Connection with the Development of Technology for Analyzing and Controlling the Biological Information Transfer Mechanism" and "Research in Connection with the Development of Developmental Engineering Technology."

The Institute for Physical and Chemical Research (RIKEN) is also involved in research for the Life Sciences Project, in thought function research, and, as a part of the Human Frontier Project, research in biological homeostasis, as well as maintaining the research base with its promotion of the Gene Bank Project and the Preservation of Microbiological Strains Project.

Furthermore, at the Research Development Corp., life sciences research is also being conducted with support from the Creative S&T Promotion System and the Commission Development System. In addition, R&D is being promoted at JAERI and at the National Institute of Radiological Sciences, and information related to the life sciences is being gathered and published at the Japan Information Center for S&T.

Cancer-related research is one particular area that is being actively promoted in accordance with the CST's "Comprehensive 10-Year Strategy for Cancer Control" (adopted at the Cabinet Minster's Meeting on Cancer Control in 1983). Activities include research in the application of heavy beam technology for cancer treatment at the National Institute of Radiological Sciences and research in cancer gene analysis at RIKEN.

Regarding recombinant DNA technology, the "Guidelines for Recombinant DNA Experimentation" was established (the Prime Minister's decision in 1979), and efforts are being made to harmoniously promote R&D that will increasingly guarantee greater safety. Incidentally, the guidelines are successively being reviewed as more scientific knowledge accumulates. The past eight revisions are being carried out, and the report entitled "Views on Experimentation Using Plants" is being released to the public.

In terms of international cooperation, research collaboration is being conducted under the Japan-US S&T Joint R&D Agreement, the Japan-Germany S&T Cooperation Agreement, and the Japan-China S&T Cooperation Agreement.

**12. Promoting R&D in Aviation Technology**

Because aviation technology is highly advanced and has great ripple effects on other areas of S&T, the promotion of aviation R&D is not only associated with merely advances in aerospace engineering, but it also fulfills a pioneering role in the development of the independent technology required for the future evolution of our country.

In line with the proposals and advisory reports set forth by the Council for Aeronautics, Electronics and Other Advanced Technologies, the STA is pushing ahead with

research at the National Aerospace Laboratory primarily in the following areas:

1) The STOL aircraft
2) Innovative air and space transport technology
3) Space transport
4) Satellites and the utilization of the space environment
5) Numerical simulation technology
6) Establishing which essential aviation and space technology can be applied in other fields

In particular, "Fan-jet STOL Aircraft Research," which focuses on the development of an experimental plane and flight testing, is being promoted throughout the institution.

The goal of this research is to establish the independent technology needed to develop the future fan-jet STOL, a plane with superior low-noise and short takeoff and landing qualities. To accomplish this goal, the low-noise STOL experimental plane, which incorporates various new technologies and whose body and engine were both developed with domestic technology, is being put through flight tests to verify the reliability of its new technology. The fan-jet STOL project is expected to dramatically improve the standard of aviation technology in our country.

In FY 1988, full-fledged flight testing of the experimental "Asuka" plane was promoted, and NAL-NASA joint international research and database services were carried forward.

Then, on the other hand, research in innovative air and space transport technology for the 21st century is being promoted, based on the reply (15 August 1986) to Inquiry No 8, "Priority Subjects in Energy-Saving Aviation Technology R&D," submitted by the Council for Aeronautics, Electronics and Other Advanced Technologies

### 13. Promoting Other Essential Comprehensive Research

#### 1) Promoting Basic Research in Optics Technology and Information Science

Optics S&T fulfills a fundamental, pioneering role in areas such as separation and analysis, processing, substance and materials, information science and electronics, and the life sciences. For this reason, "Research in Large Output, Variable Wavelength Laser and Laser Processing Technology" and "Research in Technology Using Vacuum UV Light Generation" is being conducted with support from the Coordination Funds for Promoting S&T.

On the other hand, fuzzy systems—whose operation is based on the vague kind of human reasoning that has until now been difficult to model and control, and which are seen as being able to handle very complicated lines of thought—are attracting attention in every field. Research meetings about promotional policies for fuzzy systems R&D are being held and investigations are being conducted.

#### 2) Promoting New Technology Develeopment

To promote original, domestically developed technology and to motivate the production of new technology on a commercial basis, the Research Development Corp. is conducting new technology development through continued commission work, development agency enterprises, and enterprises that develop the results of leading-edge research endeavors.

In commission enterprises, priority is given in choosing new technology to that which contributes to new industrial evolution. The work is entrusted to an enterprise and development is carried out. In development agency enterprises, special permission is obtained from national test research institutions and universities, for example, and domestic and foreign agency activities are carried out to extensively gather and study the new technology.

In enterprises that develop the results of leading-edge research endeavors, to cultivate the results of basic research generated at universities, national test research institutions, and creative S&T promotion enterprises, developmental testing aimed at establishing peripheral permission is carried out.

#### 3) Promoting Comprehensive Resource Utilization Policies

Based on its investigative deliberations on comprehensive policies for the utilization of resources, the Research Commission on Resources put together a report, endeavoring to influence the administrative policies of related ministries. Studies were also conducted on fat-dissolving ingredients in food stuffs and on matters related to storage policies for plant genetic resources.

#### 4) Promoting S&T Dissemination and Educational Activity

In striving to further S&T, it is necessary to obtain the correct understanding and cooperation from the people. In view of this need, the STA started publishing and distributing public relations magazines related to S&T, producing S&T films, and planning and broadcasting S&T programs on radio and television. Additionally, there is a Science and Technology Week and a Nuclear Power Day; local conferences for S&T promotion were held; and events designed to popularize S&T and enlighten the people about it, such as through S&T film promotions, were established. The development and utilization of atomic energy is one area in particular where educational activities are aimed at obtaining the public's extensive understanding and cooperation.

## Chapter 2. The General Promotion of S&T

### 1. S&T Policy Establishment and Promotion

Our country's S&T policies are promoted along the lines set forth in the November 1984 CST report No 11, "The Basic and Comprehensive Policy for the Promotion of Science and Technology From a Long-Term Perspective and for Coping with Changes in the Situation," and the

"Outline of the Science and Technology Policy," which the Cabinet put forth in March 1986 after accepting the "Report on the Promotion of Administrative Reform," dated July 1985, from the Provisional Council for the Promotion of Administrative Reform.

### 1) Establishment of the Basic S&T Policy

In the reply to Inquiry No 11, "The Basic and Comprehensive Policy for the Promotion of Science and Technology From a Long-Term Perspective and for Coping with Changes in the Situation," the CST indicated the general direction that governmental steps should be taken in establishing S&T policies. The policies set forth should adequately affect S&T activities throughout the nation. While also taking into consideration the guidelines for private S&T activity, the CST indicated the basis for S&T policies in the next ten years, a basis to be supported by three main themes: (1) the promotion of S&T that is rich in creativity, (2) development that achieves harmony between man and society and S&T, (3) development that stresses internationality. Building upon the ideas of Report No 11, the Cabinet decided on the Outline of the Science and Technology Policy. In this outline, which is given below, the government indicated the basis on which the presiding government is to actuate S&T promotional policies.

### Outline of the Science and Technology Policy

### I. Basic Policy

The 21st century should give rise to a more affluent society and more creative lifestyles for the people. In confronting these changes, it is our business to find ways to exactly meet the diversity of needs. And, as a means for opening up new possibilities in the future, it is our job to strive for S&T promotion that uses S&T rich in creativity .

Focusing in particular on strengthening the fundamental research that cultivates the basic soil supporting the technology of the next generation, it is our job to work at creating the technological seeds that go back to theory and phenomena, to connect these efforts to social needs, and to motivate original S&T that goes beyond revision and reform.

In such a case, the influence of S&T development ranges over broad areas—having to do with the people's lifestyle, the dignity of mankind, ethics. Keeping this idea in mind, it is our business to strive for S&T development that is harmonious with humanity. Also, keeping in mind the importance of international contributions through S&T that keep up with our country's increasing responsibilities in international society, we must take into consideration the importance of cooperation with developing countries and recent international trends in technological advancement. We must strive to internationalize every activity, organization, and person. We must actively encourage international cooperation and exchange. Through these kinds of efforts, it is our business to give adequate attention to striving for S&T development that takes an increasingly serious view of internationality.

### II. Promotion of Priority Policies

When promoting S&T that is rich in creativity, it is important to devise ways to strengthen and maintain the supporting systems and promotional conditions. With this view in mind, we will formulate the fundamental guidelines for promoting the priority policies needed in the timely support of creative S&T, continually striving to comprehensively and with mobility implement the following policies.

#### (1) Maintaining and Strengthening the Promotion System

Universities, which bear the burden of S&T research, are important in the evolution of fundamental research. Although there is a degree of independence in the way universities deal with appointed tasks and objectives, they respect the demands of society. We will strive to strengthen and achieve greater perfection in university research activities, sustain international standards, and bring our research levels even higher.

In national experimental research institutions, we will continue to appropriately revise systems to correspond with fluctuating social and economic needs, and we will expand and strengthen fundamental and pioneering R&D.

Furthermore, a foundation for ideal mid- to long-term activation of national experimental research institutions, based upon the results of CST studies, shall be established.

Even in private enterprises, there is continued expansion in the fundamental research that becomes their basis for seeking new areas of activity. In all the R&D involved in working from the basis towards application and development, the areas in which there is cooperation between industry, universities, and the government are expanding. With this view, we will strive to encourage the improvement of systems from the standpoint of promoting research exchange in industry, universities, and the government; to make the management of these systems more flexible; and to encourage the practical application of research results. We will also work towards exchange among researchers through joint research, unified research, and flowing, non-stagnant research systems, and through research meetings.

#### (2) Maintaining and Strengthening the Promotion Conditions

##### (i) Expansion of R&D Investments

Because R&D strength is largely influenced by the accumulation of knowledge and technology generated by R&D investments, we will ensure periodic R&D investment. To that end, we will work towards maintaining the environment for further activation of private activities

and for efficiency in the repletion and application of Diet funds, and we will endeavor to expand our country's national R&D investments.

**(ii) Training and Securing Talented Individuals**

In view of the fact that talent is the key to S&T promotion, we will continue to pay attention to the demands in fields which are rapidly advancing, and we will strive to educate and secure young researchers in the universities and national experimental research institutions, which are becoming the central groups in charge of fundamental research departments.

In particular, we will strive for well-rounded preparedness in education at the university department level and in education and research leadership at the graduate level. We will work towards ensuring the necessary personnel for public departments that are centered on fields unlikely to be tackled by private enterprises. We will strive to maintain the kind of working conditions that bring out the abilities of researchers.

**(iii) Strengthening the S&T Promotion Base**

In view of the remarkably increasing importance of the base that supports S&T promotion, we will strive to facilitate the generation and distribution of S&T information by building fact databases and furthering their use and by accelerating the distribution of document information; round-out the functions that private organizations cannot handle, such as the development, storage, and supply of equipment, materials, and genetic resources, for example; and maintain the conditions for activating basic activities. We will strengthen the S&T promotion base.

**(iv) Expansion of S&T International Exchange and Cooperation**

Under the basic policy indicated in I above, we will work towards furthering international mutual understanding. We will devote ourselves to vigorously expanding cooperative and international research exchange. To that end, we will strive to maintain an internationally open research system that encourages the appointment and acceptance of foreign researchers in the universities and national experimental research institutions. Additionally, we will round-out and strengthen diversified international joint research, and strive to facilitate research and information exchange and maintain conditions such that rights are protected in cooperative research.

**(v) Advancing Public Understanding and Ensuring Cooperation**

In view of the fact that science and technology permeates every corner of the economy, society, and the people's lifestyle today, we will adopt policies so that the people will come to effectively acquire a command of S&T, policies which should create the soil in which public cooperation in S&T promotion can be gained, policies which will deepen the appreciation for S&T in young people, those who will bear the burden of the next generation.

**III. Promotion of Important R&D Fields**

In order to promote S&T that is rich in creativity, the aforementioned policies are gradually being adopted. In the areas indicated below, priority is given to area (1), of course, and in areas (2) and (3) as well, importance is placed on fundamental and pioneering S&T. We will make it our business to effectively and vigorously implement R&D in these areas, under control by appropriate research evaluations.

Additionally, for each field that we should strive to promote as a priority area, basic R&D plans shall be formulated one after another, based on the 24 September 1985 Cabinet decision entitled "Concrete Policies for Promoting Tentative Administrative Reforms."

**(1) Promotion of the Fundamental and Pioneering S&T that Enables Hope for New Development**

We will work towards strongly promoting the fundamental and pioneering S&T that opens up new fields of scientific knowledge, S&T that begins with the search for innovative, original technological seeds and then nurtures those seeds. In view of the importance of basic science in these endeavors, we will aim for steady development.

Specifically, these areas are as follows.

(i) In materials, energy, and information, the so-called basic components that comprise S&T, we will inquire into the performance limitations of existing S&T, intensify investigation into and elucidation of new theories and phenomena, and investigate the possibility of new S&T that overcomes the barriers of existing S&T.
(ii) We will aim for elucidation of life phenomena together with progress in fields such as present-day molecular biology, and will investigate the possibilities for applying that knowledge.
(iii) We will deepen our understanding of the macroscopic environment surrounding humanity—the earth, space, the oceans, and mankind—and will investigate the possibility of applying that knowledge.

To these ends, we will strongly promote the following research fields.

(a) Substance and materials S&T
(b) Information and electronics S&T
(c) The life sciences
(d) Software S&T
(e) Space S&T
(f) Marine S&T
(g) Earth S&T

**(2) S&T Promotion for Economic Activation**

Internationally, economic re-activation is desired. Even domestically, we work towards sustaining and developing a vigorous economy, and the establishment of yet a firmer foundation for our country has become an important issue. Basing our reasoning on these ideas, we will work towards promoting the following S&T fields as S&T that will continue to activate the economy.

(a) Development and management of natural resources
(b) Development and utilization of energy
(c) Advancement in production technology and distribution systems
(d) Regeneration and efficient utilization of resources
(e) Improvements in social and lifestyle-oriented services

**(3) S&T Promotion for Improving the Quality of Life and Society**

Today, with the continued maturing and aging of society, and the demands for activity development that harmonizes with international society, we urge healthy development that is much better-suited for man and society than previous development that has been geared for man alone. In order to improve the quality of life and society, we will work towards promoting the following S&T fields.

(a) The promotion of mental and physical health maintenance for humanity
(b) The formation of individualistic, cultured lifestyles
(c) The formation of a comfortable, safe society
(d) The improvement of man's environment from a global perspective

(From the Planning Division of the Science and Technology Policy Bureau)

**(2) Establishing Basic Planning Policies for R&D**

The CST establishes the basic plans for fields that need to be tackled comprehensively and works towards effectively promoting R&D. To begin with, in the area of energy, CST Report No 7, "About the Basic Plans for Energy R&D," was accepted, the "Basic Plans for Energy R&D," dated August 1978, (revised for the sixth time in July 1985) is being established, and investigations for the seventh revision are now continuing. In the area of life sciences, a reply to Report No 8, "Regarding the Basis for Policies Promoting Recombinant DNA Research," was accepted, and the "Guidelines for Recombinant DNA Experimentation" (revised for the eighth time in September 1986) was established in August 1979. Additionally, Report No 10, "Regarding the Basic Plans for Pioneering and Fundamental Research and Development in the Life Sciences," was accepted and the "Basic Plans for Pioneering and Fundamental Research and Development in the Life Sciences" was established in August 1984. In the field of disaster prevention, Report No 9, "Regarding the Basic Plans for Research and Development in Connection with Disaster Prevention," was accepted and the "Basic Plans for Research and Development in Connection with Disaster Prevention" was established in July 1981.

In the field of substance and materials, Report No 14, "Regarding the Basic Plans for Research and Development in Connection with Substance and Materials-Related Science and Technology," was accepted and the "Basic Plans for Research and Development in Connection with Substance and Materials-Related Science and Technology" was established in October 1988.

Also, in human S&T fields having to do with neurology and immunology, in August 1987, the "Opinions on Basic Policies for Promotiong Neurological Science and Technology" and the "Opinions on Basic Policies for Promotiong Immunological Science and Technology" were decided upon, and an advisory report to the Prime Minister is being drawn up.

Furthermore, in the fields of information and electronics, Report No 15, "Regarding the Basic Plans for Research and Development in Connection with Information and Electronics Science and Technology," was accepted and the "Basic Plans for Research and Development in Connection with Information and Electronics Science and Technology" was established on 14 June 1989.

In the field of earth science and technology, Report No 17, "Regarding the Basic Plans for Research and Development in Connection with Earth Science and Technology," was accepted, and investigations are now continuing.

In addition to these, in space, atomic energy, and other priority fields, the Space Activities Commission is directing the "Outline for Space Development Policy" (established in March 1978 and revised in February 1984) and the "Space Development Plan" (established in March 1988), and the Atomic Energy Commission is directing the "Long-Term Nuclear Power Development and Utilization Plan" (established February 1962 and revised in June 1987).

In addition to these special basic plans, investigations into concrete policies that deal with cross-cutting items are continuing. To begin with, regarding the activation of national experimental research institutions, Report No 13, "On Mid to Long-Range Models for National Experimental Research Institutions," (August 1987) was accepted, and "The Basis of Mid to Long-Range Models for National Experimental Research Institutions," dated October 1988, was established.

Additionally, regarding maintenance of the research base, Inquiry No 16, "Regarding the Basic Guidelines on Maintaining the Science and Technology Promotion Base," (January 1988) was accepted and investigations are now being continued. Furthermore, regarding

models for international S&T as well, the "Roundtable Discussion on International Problems," is continuing under the direction of the Policy Commission, where the "Summary on International Problems Surrounding Science and Technology Today" (September 1988) was drawn up.

The CST also develops R&D reports and estimation policies based on these basic R&D plans and coordinates them on a yearly basis.

### (3) S&T Promotion with the Coordination Funds for Promoting S&T

In recent years, the tempo of technological innovation throughout the world has been accelerating, and heretofore unimaginable, new and advanced technology is continuously being developed in many different areas. These kinds of leading-edge technology are extensively tied in with diversified industrial and university domains. In comprehensively promoting these technologies in the midst of international competition for technological innovation, it has become necessary for our country to efficiently utilize and increase our limited capital and talent so that we can build a national technological foundation and continue evolving.

Consequently, efforts such as strengthening coordinated cooperation among industry, universities, and the government, coordinating R&D from a comprehensive viewpoint, and aiming for S&T policy development that achieves nationwide harmony have become extremely important. In particular, there is a strong demand for strengthening the overall coordinating functions of the Council for Science and Technology, our country's supreme deliberative organization for S&T affairs.

To cope with such a demand, the "Coordination Funds for Promoting Science and Technology" was created in the budget for FY 1981. The funds and policies are applied along the guidelines set forth by the CST, which coordinates the comprehensive promotion of important S&T affairs to promote S&T in our country.

To achieve the smooth employment of these funds, the CST established the "Basic Policy on Utilization of the Funds for Promoting S&T" in March 1981. The following points are considered to be the basis on which the funds should be applied.

#### (i) Promotion of Leading-edge, Fundamental Research

In order to actively and comprehensively continue developing original and independent technology, we will promote the leading-edge, fundamental research that is needed in the search for innovative technology seeds.

#### (ii) Promotion of R&D Requiring the Cooperation of Multiple Institutions

We will encourage R&D that is well-suited to cooperation among multiple institutions.

#### (iii) Strengthening Coordinated Cooperation among Industry, Universities, and the Government

In view of the increasingly more advanced and more complex state of R&D in recent years, to efficiently promote R&D for independent technology, we will strengthen coordinated cooperation among industry, universities, and the government, under the appropriate allotment of duties.

#### (iv) Promotion of International Joint Research

We will aim to promote the flexibility and mobility required for dealing with international joint research efforts, where the significance of efficient R&D promotion and international harmony is recognized.

#### (v) Flexibility in Coping with Emergency Situations where Research is Needed

We will aim to promote mobile R&D for coping with natural disasters, new situations and fluctuating conditions.

#### (vi) Implementing Research Evaluations and R&D Surveys and Analyses

To efficiently promote R&D, we will establish evaluation systems, adequately implement before-and-after evaluations, will inquire into needs and conduct comprehensive surveys and analyses to determine the kinds of R&D that should be promoted now and in the future.

In FY 1988 (a ¥9.2-billion budget), we are working towards concretely putting into practice efforts based on the following.

(i) In promoting S&T we will focus on those fundamental and pioneering fields in which there is a high possibility of bringing forth original, innovative technology and new scientific knowledge, fields which are leading-edge domains of even worldwide S&T. In particular, we will promote that which covers a broad spectrum of S&T and that which can be expected to fulfill a pioneering role. The emphasis will be on substance and materials S&T, where a comprehensive approach is necessary, the life sciences, and other fields such as earth S&T.

(ii) In S&T that serves to improve the quality of lifestyle and society, we will specifically promote strong R&D that meets national and social needs.

(iii) We will positively and comprehensively promote international joint research to answer the expectations of international society and to continue to fulfill our obligations as one of the scientifically and technologically advanced countries. Starting in FY 1988, in particular, we will establish anew international exchange in basic research, and, with the goal of international exchange among researchers in mind, we will encourage the acceptance of foreign researchers in our country's national research. We will also encourage international, creative basic research based on management that centers on human beings.

(iv) We will attach importance to bringing out creativity in researchers working in national experimental research institutions, and will promote priority basic research in order to create the seeds of technological innovation.
(v) We will encourage investigations in R&D promotion policies and the necessary surveys and analyses for establishing research topics.

(From the Planning Division of the Science and Technology Policy Bureau)

## 2. Summary of Science and Technology Related Budgets

The nation's S&T-related budget is composed of the "Coordination Funds for Promoting Science and Technology," the "Research-Related Funds within the Energy Measures Funds," and S&T-related funds from the general accounts and from special accounts such as the national schools' special account and the special accounts for electric power, petroleum, coal, and petroleum-alternative energies development. In FY 1988, the total S&T budget was ¥1.7605 trillion. This represented a 3.1% increase over the previous year, and if the increase in the general expenditures budget amount (the total amount for general accounts less national debt fees and local subsidies) is compared to the 1.2% increase in the previous year, the S&T-related budget is growing.

### 1) Coordination Funds for Promoting S&T

As shown in Table 1-2-1, this appropriation was ¥417.3 billion (an increase of 4.2% over the previous year).

The Coordination Funds for Promoting Science and Technology are divided into three areas according to content: "National Experimental Research Institution Expenses," "Grants, Subsidies, and Government Investment Expenses," and "Miscelleneous Administrative Expenses."

#### (i) National Experimental Research Institution Expenses

This expense, needed to carry out experimental research in national experimental research institutions, was ¥167.5 billion (an increase of 1.5% over the previous year).

Personnel expenses, ¥89.5 billion, accounted for nearly half of this. (At the end of FY 1988, 15,054 people were employed in national experimental research institutions connected with the Coordination Funds for Promoting S&T; 9,767 of these were researchers. In comparison to the previous year, the total number of employees decreased by 93, and there were 53 fewer researchers.) Other expenses include ¥33.3 billion for research operating costs (¥12.1 billion of which is the agency expense per research worker accumulated for all researcher workers) and ¥20.7 billion for special research expenses.

Incidentally, the unit FY 1988 agency appropriations based on the accumulated costs per research worker were as follows.

| | |
|---|---|
| Experimental Group I | ¥1.44 million |
| Experimental Group II | ¥1.26 million |
| Nonexperimental Group I | ¥0.91 million |
| Nonexperimental Group II | ¥0.82 million |

#### (ii) Grants, Subsidies, and Government Investment Expenses

These represent the expenditures required for grants, subsidies, etc. to outside research institutions and consist of different kinds of appropriations for trust money, commission expenses, investments, and allotted contributions. The total amounted to ¥239.3 billion (an increase of 6.3% over the previous year) and consisted primarily of ¥9.2 billion for the STA Coordination Funds for Promoting S&T, ¥96.5 billion to cover operating costs for the Space Development Corp., ¥16.0 billion to cover operating costs for the Institute for Physical and Chemical Research (RIKEN), ¥3.8 billion for the Creative S&T Promotion Project, ¥48.9 billion for scientific research grants to the Ministry of Education, ¥4.4 billion to cover grants for research in public health and welfare science for the Ministry of Health and Welfare, ¥3.8 billion for MITI's Computer Industry Promotion Policy funds, ¥2.3 billion for large-scale engineering technology R&D, and ¥3.0 billion for engineering technology for the next generation industrial base.

#### (iii) Miscelleneous Administrative Expenses

These represent the S&T-related administrative expenditures required for concerned ministries that were not covered by (i) or (ii) above. The total amount was ¥10.5 billion (an increase of 0.1% over the previous year).

### 2) Research-Related Expenses from the Energy Development Funds

The total amount for these expenses was ¥10.5 billion (an increase of 2.7% over the previous year).

Research-related expenses from the energy development funds consist primarily of ¥97.3 billion to the STA for operating costs of the Japan Atomic Energy Research Institute (JAERI), ¥62.3 billion for operating costs of the Power Reactor and Nuclear Fuel Development Corp. (PNC), ¥1.6 billion for MITI's new energy technology R&D, and ¥700 million for MITI's energy-saving technology R&D.

### 3) Other Research-Related Expenses from the General Accounts and S&T-Related Expenses from the Special Accounts

Other research-related expenses taken from the general accounts totaled ¥240.5 billion, and research-related expenses taken from the special accounts totaled ¥884.0 billion.

Other research-related expenses taken from the general accounts primarily include research-related grants to the Ministry of Education for public and private universities. Other research-related expenses taken from the

special accounts primarily include ¥75.8 billion for PNC operations, ¥621.8 billion for the Ministry of Education's R&D at the national universities, and ¥34.5 billion for MITI's new energy technology R&D.

A summary of the ministry and agency expenses mentioned above for FY 1988 is shown in Tables 1-2-1A and 1-2-1B, and that for FY 1989 is shown in Tables 1-2-2A and 1-2-2B.

**Table 1-2-1A. FY 1988 Science and Technology Budgets for Ministries and Agencies (General Accounts)**
**Unit: ¥1 million**

| Item | | | | | | | | | | (Note 4) |
|---|---|---|---|---|---|---|---|---|---|---|
| Ministry or agency | A | %change | B | %change | C | %change | A+B+C | %change | D | %change |
| Diet | 517 | -1.4 | - | - | - | - | 517 | -1.4 | 86,323 | 1.9 |
| Science Council of Japan | - | - | - | - | 903 | 5.5 | 903 | 5.5 | 903 | 5.5 |
| National Police Agency | 972 | 5.1 | - | - | - | - | 972 | 5.1 | 179,411 | 2.7 |
| Hokkaido Development Agency | 143 | 0.1 | - | - | - | - | 143 | 0.1 | 687,939 | 1.4 |
| Defense Agency | - | - | - | - | 82,700 | 11.6 | 82,700 | 11.6 | 3,700,151 | 5.2 |
| Economic Planning Agency | 716 | 0.9 | - | - | - | - | 716 | 0.9 | 43,563 | -0.8 |
| Science and Technology Agency | 170,978 | 6.4 | 159,766 | -2.6 | 9,667 | 8.1 | 340,410 | 2.0 | 340,410 | 2.0 |
| Environment Agency | 7,752 | -2.1 | - | - | - | - | 7,752 | -2.1 | 46,836 | -1.0 |
| National Land Agency | 105 | -34.1 | - | - | - | - | 105 | -34.1 | 233,833 | 1.9 |
| Ministry of Justice | 849 | 5.4 | - | - | - | - | 849 | 5.4 | 412,178 | 1.6 |
| Ministry of Foreign Affairs | - | - | 2,655 | 4.9 | 3,762 | -0.1 | 6,417 | 1.9 | 441,646 | 4.1 |
| Ministry of Finance | 337 | 0.8 | - | - | - | - | 337 | 0.8 | 1,353,235 | 2.8 |
| Ministry of Education, Science and Culture | 63,757 | 6.7 | - | - | 127,416 | 1.0 | 191,173 | 2.8 | 4,576,594 | 0.1 |
| Ministry of Health and Welfare | 32,319 | 8.1 | - | - | 1,128 | -7.9 | 33,447 | 7.5 | 10,321,123 | 2.9 |
| Ministry of Agriculture,Forestry and Fisheries | 61,195 | 0.2 | - | - | 1,847 | -0.2 | 63,042 | 0.1 | 2,556,146 | -4.6 |
| MITI | 54,652 | 0.2 | 2,260 | -18.4 | 11,471 | -0.9 | 68,383 | -0.7 | 620,186 | -4.7 |
| Ministry of Transport | 12,461 | -2.3 | - | - | 1,250 | 65.9 | 13,711 | 1.5 | 813,815 | -2.4 |
| Ministry of Posts and Telecommunications | 4,169 | 3.3 | - | - | 113 | 1,279.8 | 4,282 | 5.8 | 24,787 | 1.2 |
| Ministry of Labor | 601 | -0.1 | - | - | 0.7 | 0.0 | 602 | -0.1 | 489,029 | 0.1 |
| Ministry of Construction | 5,206 | 1.1 | - | - | 254 | -28.9 | 5,459 | -0.8 | 3,681,637 | -0.1 |
| Ministry of Home Affairs | 543 | 1.4 | - | - | - | - | 543 | 1.4 | 71,525 | -3.9 |
| Total | 417,272 | 4.2 | 164,680 | -2.7 | 240,511 | 4.7 | 822,463 | 2.9 | 32,982,107 | 1.2 |
| (Note 5) | S&T Promotion Fund | | Energy Development Fund | | Other | | Total | | | |
| General Expenditures | 417,272 | 4.2 | 461,625 | -6.8 | 32,103,210 | 1.3 | 32,982,107 | 1.2 | | |

Notes
1. A represents research appropriations earmarked in the science and technology promotion fund.
2. B represents research appropriations earmarked in the energy development fund.
3. C represents research appropriations from funds other than S&T promotion fund or the energy development fund.
4. D represents S&T budget appropriations by each agency and ministry from the general expenditures budget. The total amount represents the general expenditures for the entire government.
5. These amounts represent total amounts from general expenditures for each main fund. "Other" represents the total amount from the general expenditures that did not come from the S&T promotion fund or the energy development fund.
6. Additions of the figures in each column do not necessarily agree with the totals because the figures have been rounded off.
7. "%change" indicates the percent change since FY 1987.

**Table 1-2-1B. FY 1988 Science and Technology Budgets for Ministries and Agencies (Special Accounts and Totals)**
**Unit: ¥1 million**

| Item | | | | | | | | | (Note 4) |
|---|---|---|---|---|---|---|---|---|---|
| Ministry or agency | A | %change | change | B | %change | change | C | %change | change |
| Diet | 517 | -1.4 | -8 | - | - | - | 517 | -1.4 | -8 |
| Science Council of Japan | 903 | 5.5 | 47 | - | - | - | 903 | 5.5 | 47 |
| National Police Agency | 972 | 5.1 | 47 | - | - | - | 972 | 5.1 | 47 |
| Hokkaido Development Agency | 143 | 0.1 | 0.1 | - | - | - | 143 | 0.1 | 0.1 |
| Defense Agency | 82,700 | 11.6 | 8,565 | - | - | - | 82,700 | 11.6 | 8,565 |
| Economic Planning Agency | 716 | 0.9 | 7 | - | - | - | 716 | 0.9 | 7 |
| Science and Technology Agency | 340,410 | 2.0 | 6,736 | 99,783 | 0.9 | 932 | 440,193 | 1.8 | 7,768 |
| Environment Agency | 7,752 | -2.1 | -163 | - | - | - | 7,752 | -2.1 | -163 |
| National Land Agency | 105 | -34.1 | -54 | - | - | - | 105 | -34.1 | -54 |
| Ministry of Justice | 849 | 5.4 | 43 | - | - | - | 849 | 5.4 | 43 |
| Ministry of Foreign Affairs | 6,417 | 1.9 | 118 | - | - | - | 6,417 | 1.9 | 118 |
| Ministry of Finance | 337 | 0.8 | 3 | 641 | -4.9 | -33 | 978 | -3.0 | -31 |
| Ministry of Education, Science and Culture | 191,173 | 2.8 | 5,241 | 621,781 | 4.6 | 27,528 | 812,954 | 4. 2 | 32,780 |
| Ministry of Health and Welfare | 33,447 | 7.5 | 2,336 | 10,612 | 22.7 | 1,962 | 44,059 | 10.8 | 4,298 |
| Ministry of Agriculture, Forestry and Fisheries | 63,042 | 0.1 | 93 | 3,600 | -5.3 | -200 | 66,642 | -0.2 | -107 |
| MITI | 68,383 | -0.7 | -488 | 152,843 | 0.2 | 305 | 221,226 | -0.1 | -183 |
| Ministry of Transport | 13,711 | 1.5 | 199 | 916 | -8.8 | -88 | 14,627 | 0.8 | 111 |
| Ministry of Posts and Telecommunications | 4,282 | 5.8 | 236 | 26,000 | 4.0 | 1,000 | 30,282 | 4.3 | 1,236 |
| Ministry of Labor | 601 | -0.1 | -0.4 | 3,106 | 2.4 | 73 | 3,708 | 2.0 | 72 |
| Ministry of Construction | 5,459 | -0.8 | -46 | - | - | - | 5,459 | -0.8 | -46 |
| Ministry of Home Affairs | 543 | 1.4 | 7 | - | - | - | 543 | 1.4 | 7 |
| Total | 822,463 | 2.9 | 22,921 | 893,282 | 3.5 | 31,489 | 1,715,746 | 3.2 | 53,410 |

Notes
1. A represents S&T appropriations from general accounts.
2. B represents S&T appropriations from special accounts.
3. C represents total amounts for the S&T budgets.
4. "%change" indicates the percent change since FY 1987.
5. "change" indicates increases or decreases since FY 1987.
6. Additions of the figures in each column do not necessarily agree with the totals because the figures have been rounded off.
7. In the S&T budget appropriations from the Ministry of Finance's Special Accounts for Industrial Investment, ¥4.7 billion was appropriated in the STA budget for operations of the Japan Information Center of Science and Technology, ¥2.6 billion was appropriated from the Basic Promotion Funds for Research and Relief of Adverse Side Effects in Pharmaceuticals in the Ministry of Health and Welfare's budget for capital investments and loans for experimental research in pharmaceutical technology, ¥3.6 billion was appropriated in the Ministry of Agriculture, Forestry and Fisheries' budget for operations of the Biotechnology Research Advancement Institute, and ¥26 billion was appropriated in overlapping budgets of the Ministry of Posts and Telecommunications and MITI for operations of the Key Technology Research Advancement Center. (However, this sum was only counted once to avoid redundancy in the total.)

**Table 1-2-2A. FY 1989 Science and Technology Budgets for Ministries and Agencies (General Accounts)**
**Unit: ¥1 million**

| Item | | | | | | | | (Note 4) |
|---|---|---|---|---|---|---|---|---|
| Ministry or agency | A | %change | B | %change | C=A+B | %change | D | %change |
| Diet | 533 | 3.0 | - | - | 533 | 3.0 | 89,037 | 3.1 |
| Science Council of Japan | - | - | 867 | -4.0 | 867 | -4.0 | 1,020 | 13.0 |
| National Police Agency | 1,020 | 4.9 | - | - | 1,020 | 4.9 | 187,250 | 4.4 |
| Hokkaido Development Agency | 147 | 3.1 | - | - | 147 | 3.1 | 699,746 | 1.7 |
| Defense Agency | - | - | 93,068 | 12.5 | 93,068 | 12.5 | 3,919,650 | 5.9 |
| Economic Planning Agency | 764 | 6.7 | - | - | 764 | 6.7 | 49,210 | 13.0 |
| Science and Technology Agency | 189,400 | 10.8 | 166,043 | -2.0 | 355,442 | 4.4 | 355,442 | 4.4 |
| Environment Agency | 7,882 | 1.7 | - | - | 7,882 | 1.7 | 48,406 | 3.4 |
| Ministry of Justice | 871 | 2.6 | - | - | 871 | 2.6 | 429,701 | 4.3 |
| Ministry of Foreign Affairs | - | - | 6,408 | -0.1 | 6,408 | -0.1 | 466,643 | 5.7 |
| Ministry of Finance | 348 | 3.3 | - | - | 348 | 3.3 | 1,394,975 | 3.1 |
| Ministry of Education, Science and Culture | 68,439 | 7.3 | 128,366 | 0.7 | 196,805 | 2.9 | 4,637,929 | 1.3 |
| Ministry of Health and Welfare | 36,371 | 12.5 | 1,161 | 2.9 | 37,531 | 12.1 | 10,837,194 | 5.0 |
| Ministry of Agriculture, Forestry and Fisheries | 62,350 | 1.9 | 1,929 | 4.5 | 64,279 | 2.0 | 2,541,424 | -0.6 |
| MITI | 55,799 | 2.1 | 13,628 | -0.7 | 69,427 | 1.5 | 695,284 | 12.1 |
| Ministry of Transport | 13,225 | 6.1 | 2,162 | 73.0 | 15,387 | 12.2 | 813,577 | 0.0 |
| Ministry of Posts and Telecommunications | 4,341 | 4.1 | 105 | -6.8 | 4,447 | 3.8 | 25,617 | 3.3 |
| Ministry of Labor | 612 | 1.8 | 1 | 0.0 | 612 | 1.8 | 487,924 | -0.2 |
| Ministry of Construction | 5,376 | 3.3 | 313 | 23.3 | 5,689 | 4.2 | 3,750,453 | 1.9 |
| Ministry of Home Affairs | 555 | 2.2 | - | - | 555 | 2.2 | 104,445 | 46.0 |
| Total | 448,033 | 7.4 | 414,049 | 2.2 | 862,081 | 4.8 | 34,080,487 | |

Notes
1. A represents research appropriations earmarked in the science and technology promotion fund.
2. B represents general accounts research appropriations from funds other than S&T promotion fund.
3. C is the sum of A and B.
4. D represents S&T budget appropriations by each agency and ministry from the general expenditures budget. The total amount represents the general expenditures for the entire government.
5. Additions of the figures in each column do not necessarily agree with the totals because the figures have been rounded off.
6. "%change" indicates the percent change since FY 1988.

**Table 1-2-2B. FY 1989 Science and Technology Budgets for Ministries and Agencies (Special Accounts and Totals)**
**Unit: ¥ 1 million**

| Ministry or agency | A | %change | change | B | %change | change | C=A+B | %change | change | D=100xB/C(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Diet | 533 | 3.0 | 16 | - | - | - | 533 | 3.0 | 16 | 0 |
| Science Council of Japan | 867 | -4.0 | 36 | - | - | - | 867 | -4.0 | -36 | 0 |
| National Police Agency | 1,020 | 4.9 | 48 | - | - | - | 1,020 | 4.9 | 48 | 0 |
| Hokkaido Development Agency | 147 | 3.1 | 4 | - | - | - | 147 | 3.1 | 4 | 0 |
| Defense Agency | 93,068 | 12.5 | 10,367 | - | - | - | 93,068 | 12.5 | 10,367 | 0 |
| Economic Planning Agency | 764 | 6.7 | 48 | - | - | - | 764 | 6.7 | 48 | 0 |
| Science and Technology Agency | 355,442 | 4.4 | 15,032 | 111,181 | 11.4 | 11,397 | 466,623 | 6.0 | 26,430 | 23.8 |
| Environment Agency | 7,882 | 1.7 | 131 | - | - | - | 7,882 | 1.7 | 131 | 0 |
| Ministry of Justice | 871 | 2.6 | 22 | - | - | - | 871 | 2.6 | 22 | 0 |
| Ministry of Foreign Affairs | 6,408 | -0.1 | -9 | - | - | - | 6,408 | -0.1 | -9 | 0 |
| Ministry of Finance | 348 | 3.3 | 11 | 738 | 15.2 | 97 | 1,087 | 11.1 | 108 | 67.9 |
| Ministry of Education, Science and Culture | 196,805 | 2.9 | 5,632 | 657,517 | 5.7 | 35,735 | 843,322 | 5.1 | 41,367 | 77.0 |
| Ministry of Health and Welfare | 37,531 | 12.2 | 4,084 | 10,838 | 2.1 | 226 | 48,370 | 9.8 | 4,311 | 22.4 |
| Ministry of Agriculture, Forestry and Fisheries | 64,279 | 2.0 | 1,237 | 3,400 | -5.6 | -200 | 67,679 | 1.6 | 1,037 | 5.0 |
| MITI | 69,427 | 1.5 | 1,044 | 164,213 | 7.4 | 11,370 | 233,640 | 5.6 | 12,414 | 70.3 |
| Ministry of Transport | 15,387 | 12.2 | 1,676 | 913 | -0.3 | -3 | 16,300 | 11.4 | 1,673 | 5.6 |
| Ministry of Posts and Telecommunications | 4,447 | 3.8 | 164 | 26,000 | 0.0 | 0 | 31,447 | 0.5 | 164 | 85.4 |
| Ministry of Labor | 612 | 1.8 | 11 | 3,945 | 27.0 | 839 | 4,557 | 22.9 | 850 | 86.6 |
| Ministry of Construction | 5,689 | 4.2 | 229 | - | - | - | 5,689 | 4.2 | 229 | 0 |
| Ministry of Home Affairs | 555 | 2.2 | 12 | - | - | - | 555 | 2.2 | 12 | 0 |
| Total | 862,081 | 4.8 | 39,618 | 952,745 | 6.7 | 59,463 | 1,814,827 | 5.8 | 99,081 | 52.5 |

Notes
1. A represents S&T appropriations from general accounts.
2. B represents S&T appropriations from special accounts.
3. C represents total amounts for the S&T budgets.
4. D represents the share of appropriations from special accounts.
5. "%change" indicates the percent change since FY 1987.
6. "change" indicates increases or decreases since FY 1987.
7. Additions of the figures in each column do not necessarily agree with the totals because the figures have been rounded off.
8. In the S&T budget appropriations from the Ministry of Finance's Special Accounts for Industrial Investment, ¥ 4.4 billion was appropriated in the STA budget for operations of the Japan Information Center of Science and Technology, ¥ 2.4 billion was appropriated from the Basic Promotion Funds for Research and Relief of Adverse Side Effects in Pharmaceuticals in the Ministry of Health and Welfare's budget for capital investments and loans for experimental research in pharmaceutical technology, ¥ 3.4 billion was appropriated in the Ministry of Agriculture, Forestry and Fisheries' budget for operations of the Biotechnology Research Advancement Institute, ¥ 2.2 billion was appropriated in MITI's budget for operations of the New Energy and Industrial Technology Comprehensive Research Institute, and ¥ 26 billion was appropriated in overlapping budgets of the Ministry of Posts and Telecommunications and MITI for operations of the Key Technology Research Advancement Center. (However, this sum was only counted once to avoid redundancy in the total.)
(From the Coordination Division of the Science and Technology Policy Bureau)

## 3. Controlling Policies for Estimating S&T Expenses

The Science and Technology Agency implemented regulations for policies having to do with estimating S&T-related expenses. In FY 1988, when it came time to roughly determine the requirements for FY 1989 expenses, the STA used the following policy as a basis. The STA prescribed common guidelines to ensure mutual base expenses and also regulated policies, in each priority area that required it, for estimating expenses in connection with special research topics.

### (1) Basic Policy

When it came time to regulate policies for estimating FY 1988 S&T-related expenses, we not only paid adequate attention to advisory reports from the CST and other deliberative councils concerned with the promotion of S&T, but also established the "Basic Guidelines on Regulatory Policies for Estimating FY 1989 Science and Technology Related Expenses," which is given below. The director general of the STA notified the relevant ministries and agencies of these guidelines and requested that the guidelines be reflected in estimating requirements.

(Text of Basic Policy)

In our country's current S&T promotion, along the lines of the basic policies of the "Outline of the Science and Technology Policy" (a March 1986 Cabinet decision), we must continue to give adequate consideration to S&T development that is harmonious with man, society, and the environment, and to development that emphasizes internationality, from the conceptual standpoint of the importance of international contributions in the realm of S&T. We must continually strive to promote S&T that is rich in creativity, and S&T centered on the strengthening of fundamental research. Henceforth, with regard to the important policies set forth in the outline, R&D analyses and evaluations and adequate policies in accordance with each administrative agency will continue to be carried out; and there will be mutual cooperation among related administrative organizations. Encouraging this is vitally important, and we must take into special consideration the S&T-related expenses so required.

In our country today, policy management from the perspective of "Japan living together with the world" is sought after in not just economic but in all areas, even in the S&T area. For global S&T development, fundamental research that has the quality of being public property is indispensable. This kind of research must be intensified. Efforts must also be made towards positive international contributions, in areas such as facilitating the free distribution of research results. Also, in the area of international S&T cooperation, such as in the rebuilding of the Japan-US S&T framework, expectations for our country are building. Under the influence of this kind of situation, we must continue to work towards strengthening S&T cooperation through international joint research and through personnel exchange and training.

On the other hand, there are demands for economic structural adjustments to correct foreign economic imbalances, to cope with actualizing a rich lifestyle for the people and other such tasks assigned to our country, and to convert our national economy to one that is harmonious with the global economy. S&T is crucial in opening up a new frontier for an economic society. For our country, it is necessary to build a 21st century-oriented evolutionary foundation by stressing creative R&D to propel the conversion towards fields such as advanced production technology, by rounding out highly intellectual wealth and manmade wealth, and by generating intelligent social capital.

The regulation of policies for estimating FY 1989 S&T-related expenses is based on the concepts mentioned above, the basic guidelines set forth in the Outline of the Science and Technology Policy, the Policy Committee of the Council for Science and Technology's "Preferential Guidelines for the Promotion of Science and Technology in FY 1989" (July 1988), together with basic plans, starting with the Prime Minister's decision entitled "On Mid to Long-Range Models for National Experimental Research Institutions" (October 1987), and recent reports from various deliberative councils. The policy regulations take numerous situations into careful consideration, and in aiming for the effective and efficient promotion of R&D related to S&T, stress the following points.

### I. Important S&T Promotion Policy Items

#### (1) Promotion of Fundamental and Pioneering R&D and Repletion of Creative Talent

We will open new fields of scientific knowledge and will strengthen and amplify creative fundamental and pioneering R&D that cultivates the next generation of technology. Particularly, in view of the importance of the nation's role in fundamental and pioneering R&D, we will strive to round out the fundamental and pioneering R&D in national experimental research institutions, continuing to give sufficient consideration to that which is harmonious with humanity and society and to development that stresses internationality. As a part of this, we will endeavor to expand experimental research expenditures in national experimental research and other institutions.

Additionally, we will put effort into cultivating and ensuring talent for the continued positive promotion of S&T that is rich in creativity. In particular, we will strive to strengthen and amplify the talent of young researchers in national experimental research institutions, which have become the central groups in charge of basic departments, and will work towards maintaining conditions that make the most of researchers' capabilities.

#### (2) Expanding International Exchange and Cooperation

We will open up internationally by accepting and promoting foreign researchers. We will endeavor to furnish attractive research environments and will facilitate a variety of joint international research and the exchange of researchers and information. As a part of this, we will endeavor to maintain the systems and increase the expenditures needed for accepting and employing foreign researchers, sending our country's researchers abroad, implementing joint research, and facilitating the international distribution of S&T information.

**(3) Strengthening the S&T Promotion Base and Furthering Research Exchange**

We will strive to expand materials, supply functions for genetic resources, and development and maintenance of equipment and machinery for facilitating the distribution and production of S&T information. We will also strive to strengthen and amplify the S&T promotion base, with a mid- to long-range perspective, by working towards a steady establishment of expanded services for new equipment and facilities and by taking measures to deal with detiorating equipment and facilities of national experimental research and other institutions.

Different fields in every part of R&D, from basic research to application and development, and the domains in which industry, universities, and the government cooperate are expanding. In view of this and in accepting the enforcement of the Research Exchange Promotion Law and the Cabinet decision on basic policies for managing systems related to the promotion of research exchange, we will strive not only to strengthen and amplify joint research and research exchange, but will also encourage cooperation that goes beyond the boundaries of R&D organizations, participation in research conference, and other avenues through which exchange occurs among researchers.

**II. What should be Promoted as Priority R&D**

In order to promote S&T that is rich in creativity, in the areas indicated below, priority is given to area (1), of course, and in areas (2) and (3) as well, importance is placed on fundamental and pioneering S&T. We will make it our business to effectively and vigorously implement R&D in these areas.

(1) R&D Related to Fundamental and Pioneering S&T

In view of the importance that has come to be associated with the continued aggressive promotion of fundamental and pioneering S&T that, beginning with the search for innovative, original technological seeds and then nurturing those seeds, opens up new fields of scientific knowledge, we will strongly promote the following fundamental and pioneering S&T fields, fields in which new development can be anticipated.

(a) Substance and materials S&T
(b) Information and electronics S&T
(c) The life sciences
(d) Software S&T
(e) Space S&T
(f) Marine S&T
(g) Earth S&T

In substance and materials S&T, we will promote R&D along the lines set forth in "Basic Plans for Research and Development in Connection with Substance and Materials-Related Science and Technology" (October 1987, Prime Minister's decision).

Regarding fundamental and pioneering technology in the life sciences, we will promote R&D along the lines set forth in "Basic Plans for R&D in Fundamental and Pioneering Life Science Technology" (August 1984 Prime Minister's decision). Also, in the fields of neurology and immunology, we will promote R&D along the lines set forth in the "Opinions on Basic Policies for Promoting Neurological Science and Technology" (August 1987, CST) and the "Opinions on Basic Policies for Promoting Immunological Science and Technology" (August 1987, CST), respectively.

**(2) R&D in S&T for Economic Re-activation**

Internationally, economic re-activation is desired. Even domestically, we will work towards sustaining and developing a vigorous economy, and the establishment of yet a firmer foundation for our country has become an important issue. Basing our reasoning on these ideas, we will work towards promoting the following S&T fields as S&T that will continue to activate the economy.

(a) Development and management of natural resources
(b) Development and utilization of energy
(c) Advancement in production technology and distribution systems
(d) Regeneration and efficient utilization of resources
(e) Improvements in social and lifestyle-oriented services

In the area of energy development and utilization, we will promote R&D in petroleum-alternative energies, starting with nuclear power, along the lines set forth in "Basic Plans for Energy R&D" (July 1985 Prime Minister's decision), together with R&D that contributes to the effective utilization of energy.

**(3) R&D in S&T for Improving the Quality of Life and Society**

Today, with the continued maturing and aging of society, and the demands for activity development that harmonizes with international society, we urge healthy development that is much better-suited for man and society than previous development that has been geared for man alone. In order to improve the quality of life and society, we will work towards promoting the following S&T fields.

(a) The promotion of mental and physical health maintenance for humanity
(b) The formation of individualistic, cultured lifestyles
(c) The formation of a comfortable, safe society
(d) The improvement of man's environment from a global perspective

We will promote R&D along the lines set forth in the "10-Year Comprehensive Anti-Cancer Strategy" (June 1973, decision by the Cabinet Meeting on Anti-cancer Measures) and the "Opinions on Basic Policies for

Cancer Research (July 1984, CST). Regarding anti-AIDS measures, we will promote R&D along the lines set forth in the "Outline on Comprehensive Anti-AIDS Measures" (February 1987 decision by the Cabinet Meeting on Anti-AIDS Measures). Regarding measures for dealing with an aged society, we will promote R&D along the lines set forth in the "Outline on Measures for Coping with an Aged Society" (June 1987, Cabinet decision) and the "Opinions on Basic Policies for S&T Promotion in Coping with an Aged Society (May 1986, CST). In the field of disaster prevention, we will promote R&D that contributes to comprehensive disaster prevention measures along the lines set forth in "Basic Plans for R&D Related to Disaster Prevention" (July 1981, Prime Minister's decision).

**Common Guidelines**

To assist in determining common S&T-related expenses, such as the agency expense per research worker accumulated for all researcher workers, before the ministries and agencies settled on their approximate requests, a Policy Regulation Liaison Meeting was held and unit cost requests were adjusted. By way of the report entitled "On the Common Guidelines to be Used when Estimating Science and Technology Expenses for FY 1989," the STA presented the contents of the following text to ministries and agencies and requested the Ministry of Finance to carry out the demands.

(Text of Common Guidelines)

**(i) Agency Expense Per Research Worker Accumulated for All Researcher Workers Unit costs based on the formula which computes agency expenses for all research workers are given in the table below. Incidentally, unit cost divisions for non-experimental categories I and II have been abolished and are now grouped together as a single category.**

Unit: ¥1000

| Category | FY 1989 Unit Cost Request |
|---|---|
| Experimental Group I | ¥1,440 |
| Experimental Group II | ¥1,260 |
| Non-experimental Group | ¥910 |

**(ii) Special Expenses**

So as not to hinder the execution of experimental research, we will request the necessary expenditures for expensive machinery and apparatus purchases, test material purchases which necessitate huge expenses, and special expenses for maintaining specific institutions.

**(iii) Expenses for Attending Academic Meetings**

We will request these expenses according to the same formula as last year. Unit costs for travel to and attendance at academic meetings and the number of times one may participate will be the same as last year.

**(iv) Expenses for Research Facilities and Equipment Maintenance**

In order to establish, from a mid- to long-range viewpoint, stable maintenance operations, we will request the necessary expenditures for expanding and dealing with the detioration of research facilities and equipment.

Incidentally, legislative proposals for introducing the "Consumption Tax" in FY 1989 are being brought before the Diet. So as not to hinder experimental research, we will take the appropriate measures, as the need arises, with S&T-related expenses that will accompany the approval and adoption of the tax.

**(3) Regulation of Policies for Estimating Expenses Related to Special Research Topics**

We conducted a hearing on the relevant ministries' and agencies' plans for approximate requests in the FY 1989 budget and carried out the regulations needed to eliminate overlap and intensify mutual cooperation, where necessary, among concerned organizations.

Approximate requests from the organizations involved could be carried through via these regulations, but we would like the proposed S&T budget for FY 1989, shown in Tables 1-2-2A and 1-2-2B to be used as a reference for the approved FY 1989 budget that is drawn up according to these regulations.

(From the Coordination Division of the Science and Technology Policy Bureau)

**4. Improving the Treatment of Public Research Employees**

**(1) Demands for Improved Treatment of Public Research Employees In striving to improve the treatment accorded to those employed in public research, the STA gathers together the opinions of relevant ministries and agencies and every year presents its demands to the National Personnel Authority.**

**(2) Results of the Demands**

Based on the FY 1988 recommendations from the National Personnel Authority, the following kinds of measures were put into effect.

**1 On Settling Differences between Salary Increases of National University Faculty and Public Research Employees, Especially Young Employees**

The average increase for both research and educational (1) occupations was 2.3%.

However, if Class 2 research occupations, which applies to young research employees, is compared to Class 2 educational (1) occupations, the researchers had a slightly higher rate of increase, 2.5%, than the educators, 2.4%.

**2 On the Increase in Provision Rates for Special Adjustments to Salaries of Public Research Employees**

It was noticed that provision rates for special adjustments to salaries were raised to 25% for three people, 20% for two people, 16% for 21 people, and 12% for 52 people.

(From the Research and Development Promotion Division of the Science and Technology Promotion Bureau)

**5. Education of Scientists and Technicians**

**(1) The General Education of Scientists and Technicians**

Until it is accompanied by a wealth of abundant R&D and excellent talent, scientific and technological development is not expected. From now on, particularly, in working even harder towards that development, much is expected of those with superior talent, and the education and advantageous employment of all-round, creative people is necessary.

For these reasons, the STA has become eagerly involved, more so than in the past, with nurturing talent: establishing foreign and domestic systems for study abroad, striving for activation in the national experimental research institutions and the accompanying improvement in researchers' natures. Additionally, in recognition of the importance of both securing excellent research personnel in national experimental research institutions and dealing with researchers, who are anxious and devoted to their work, in such a way as to adequately bring out their capabilities, every year since FY 1961 the STA has been consulting with relevant ministries and agencies and making proposals to the National Personnel Authority on improving the treatment of public research employees.

(From the Research and Development Promotion Division of the Science and Technology Promotion Bureau)

**(2) Education of Atomic Energy Technicians The training and education of atomic energy technicians is conducted at the Japan Atomic Energy Research Institute (JAERI), the National Institute of Radiological Sciences, and universities.**

At the JAERI Radio-Isotope and Atomic Reactor Training Institute, and at the National Institute of Radiological Sciences, respective training courses are taught. The state of this training is shown in Table 1-2-3.

(From the Technology Development Division of the Atomic Energy Bureau)

**Table 1-2-3. Summary of Atomic Energy Technician Training Institutes (March 1989)**

| Training Institute | Curriculum | Capacity | Year Established | | Total # Trainees | Trainee Prerequisites and Target Type |
|---|---|---|---|---|---|---|
| JAERI Radio-Isotope and Nuclear Reactor Training Institute (Atomic Reactor Training Division) | | | | | | |
| | Advanced Curriculum | 2 | 1959 | 1 year | 66 | University science or engineering graduate planning to exclusively investigate deeper into one of the specialized atomic energy fields |
| | General Curriculum | 32 | 1959 | 5-8 months | 1,455 | University science or engineering graduate currently engaged in atomic energy research or technology, or who plans to do so in the future |
| | Atomic Reactor Engineering Specialist Curriculum | 24 | 1976 | 3 months | 326 | University science or engineering graduate currently engaged in atomic energy research or technology, or who plans to do so in the future (because it is a short course, however, taking the chief atomic reactor technician's oral exam is not necessary) |
| | Health Physics Specialist Curriculum | 24 | 1969 | 2 months | 531 | University science or engineering, or highschool graduate with at least 2 years experience in radiation control |
| | Radiation Protection Specialist Curriculum | 24 | 1982 | 1 month | 295 | In-house employees with over 2 years of radiation-related work experience |
| (Short Courses) | Introductory Course in Atomic Energy | 24 | 1976 | 2 weeks | 649 | Industrial-highschool-level background with at least 2 years of work experience |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Nuclear Materials Engineering Course | 24 | 1970 | 17 days | 823 | University science or engineering, or highschool graduate with at least 4 years experience handling nuclear materials |
| | Radiaoactive Waste Disposal Course | 24 | 1979 | 12 days | 361 | University science or engineering, or highschool graduate with at least 2 years experience handling nuclear materials |
| | Atomic Energy Disaster Prevention Measures Course | 32x 2 times | 1979 | 12 days | 639 | Regular highschool graduate who, as a rule, is engaged in atomic energy related work in a local public group |
| | Theory of Atomic Reactors Course | 24x 2 times | 1979 | 6 days | 665 | University science or engineering graduate with a basic knowledge of atomic energy (ideal for those taking the atomic reactor technician exam) |
| | Atomic Energy Disaster Prevention Course (Basic Technology) | 50x13 times | 1980 | 2 days | 5,427 | In local prefectures with nuclear generator plants, local public employees who engage in atomic energy disaster prevention services (including police and firemen) |
| | Other | - | - | - | 1,920 | (courses need not be completed) |
| | Radio-Isotope Training Division | | | | | |
| | Advanced Curriculum | 16 | 1960 | 49 days | 230 | Completion of Basic Curriculum or at least equivalent scholastic ability (cancelled after 4/75) |
| | Basic Curriculum | 32 | 1957 | 18 days | 6,863 | Scholastic abilities in university-level physical chemistry |
| | Specialist Curriculum | 16-32 | 1963 | 1-2 weeks | 3,247 | No special qualifications but some degree of understanding of physical chemistry |
| | Designated Short-term Course | 16-32 | 1977 | 2-5 days | 1,503 | Passed the Radioactive Treatment Chief Technician (1st level) Exam |
| National Institute of Radiological Sciences | Radiation Protection Curriculum | 30x 3 times | 1959 | 5 weeks | 2,255 | University or junior college graduate or person with equivalent scholastic ability, engaged in or seeking radiation work |
| | Radiation and Nuclear Medicine Basic Curriculum | 14 | 1961 | 5 weeks | 596 | Licensed physicians and dentists |
| | RI Utilization in Biology Curriculum | 16 | 1965 | 5 weeks | 354 | University science curriculum graduate or person with equivalent scholastic ability, engaged in or seeking research work in basic medicine, biology, biochemistry, or agriculture |
| | Environmental Radiation Monitoring Technology Curriculum | 30 | 1978 | 2 weeks | 280 | University or junior college graduate or person with equivalent scholastic ability, engaged in or seeking work in radioactivity surveying (urban and rural prefecture employees) |
| | Radiation Exposure Emergency Rescue Training Curriculum | 15x 2 times | 1969 | 1 week | 370 | Necessary relief personnel of atomic energy facilities or related organizations who engage in first aid and relief radiation work during a radiation exposure emergency and who already have basic knowledge about radiation measurement and control, or health nurses and nurses (men) of these organizations |
| Japan Atomic Power Co. Comprehensive Training Center | Atomic Energy Basic Study Course | A25 | 1968 | A 3.5 months | A675 | Highschool graduate or person with at least equivalent scholastic ability |
| | Atomic Energy Basic Study Course | B15 | 1968 | B 3.5 months | B305 | Highschool graduate or person with at least equivalent scholastic ability |
| | Standard Training Course No 1 | 8 | 1974 | 12 weeks | 388 | Recommendation |
| | Short-term Basic Course No 1 | 4 | 1978 | 4 weeks | 277 | Recommendation |

| | | | | | | |
|---|---|---|---|---|---|---|
| BWR Co. Operations Training Center | Retraining Course No 1 | 4 | 1974 | 9 days | 754 | |
| | Special Training Course No 1 | | 1975 | | 602 | Length of training time and course contents depend on previous arrangements made with the organization sending the trainees |
| | Advanced Training Course No 1 | 4 | 1983 | 5 days | 197 | |
| | Basic Studies Training Course | 12 | 1983 | 10 days | 256 | |
| | Standard Training Course No 2 | 8 | 1983 | 12 weeks | 111 | |
| | Short-term Basic Course No 2 | 4 | 1983 | 4 weeks | 86 | |
| | Special Training Course No 2 | | 1983 | | 242 | Length of training time and course contents depend on previous arrangements made with the organization sending the trainees |
| | Retraining Course No 2 | 4 | 1984 | 9 days | 131 | |
| | Family Study Course No 1 | | 1976 | 1 day | 1,025 teams | |
| | Family Study Course No 2 | | 1983 | 1 day | 220 teams | |
| | Advanced Training Course No 2 | 4 | 1985 | 5 days | 52 | |
| Japan Atomic Power Co. Training Center | Initial Training Course | 12 | 1974 | 22 weeks | 559 | Recommendation |
| | Retraining | | | | | |
| | General Course | 12 | 1974 | 10 days | 1,411 | |
| | Advanced Course | 12 | 1984 | 5 days | 654 | |
| | Superintendent Course | 12 | 1979 | 5 days | 727 | |
| | Repairmen Cooperative Training Course | | 1979 | 1 day | 493 teams | |
| | Special Training Course | | 1974 | | 338 | Length of training time and course contents depend on previous arrangements made with the organization sending the trainees |
| Ibaraki Professional Training Short-term College | Atomic Energy Science | 20 | 1962 | 2 years | 292 | Highschool graduate or person with at least equivalent scholastic ability (Name changed in April 1984) |

### (3) Overseas Atomic Energy Research Personnel System

With the goal of improving the nature of the people such as government employees (but excluding university researchers) engaged in executing national policies on atomic energy R&D and utilization for peaceful purposes, programs for sending these people abroad are being implemented every year. In FY 1988, based on these intentions, 30 individuals were found eligible. Table 1-2-4 shows the breakdown.

**Table 1-2-4. Overseas Atomic Energy Related Research Personnel FY 1988 Test Results**

| Affiliation | Nominees | Successful Applicants |
|---|---|---|
| Science and Technology Agency | 21 | 9 |
| MITI | 6 | 9 |
| (Patent Office) | 1 | 1 |
| Ministry of Health and Welfare | 1 | 0 |
| Ministry of Transport | 1 | 1 |
| Ministry of Construction | 1 | 1 |
| Subtotal | 31 | 15 |
| Power Reactor and Nuclear Fuel Development Corp. | 8 | 8 |
| Japan Atomic Energy Research Institute | 6 | 6 |

**Table 1-2-4. Overseas Atomic Energy Related Research Personnel FY 1988 Test Results (Continued)**

| Affiliation | Nominees | Successful Applicants |
|---|---|---|
| Private enterprises | 1 | 1 |
| Subtotal | 15 | 15 |
| Total | 46 | 30 |

(From the Research and International Affairs Division of the Atomic Energy Bureau)

### (4)Domestic Research Personnel Exchange System

This system sends researchers and research assistants employed in national experimental research institutions to national universities, and by making them engage in research, it is designed to improve the nature of research personnel.

In FY 1988, 24 researchers and 10 research assistants were sent to national universities. (Table 1-2-5)

(From the Research and Development Promotion Division of the Science and Technology Promotion Bureau)

**Table 1-2-5. Personnel Dispatched in Domestic Exchange System and Transitions (Unit: People)**

| Year | FY 1987 | | FY 1988 | |
|---|---|---|---|---|
| Ministry or Agency | Researchers | Research Assistants | Researchers | Research Assistants |
| National Police Agency | 1 | | 2 | |
| Hokkaido Development Agency | | | | |
| STA | | 8 | 1 | 4 |
| Environment Agency | 1 | 1 | | |
| Ministry of Finance | 1 | | 1 | |
| Ministry of Education, Science and Culture | | | | |
| Ministry of Health and Welfare | | | | |
| Ministry of Agriculture, Forestry and Fisheries | 11 | | 12 | |
| MITI | 5 | 1 | 7 | |
| Ministry of Transport | 3 | 1 | | |
| Ministry of Posts and Telecommunications | | 1 | | 2 |
| Ministry of Labor | | | | |
| Ministry of Construction | | 2 | 1 | 4 |
| Ministry of Home Affairs | | 1 | | |
| Total | 22 | 15 | 24 | 10 |
| | 37 | | 34 | |

Note: Researchers sent since 1965, research assistants sent since 1973

### (5) Overseas Space Development Research Personnel System

In order to raise the our country's standards of S&T with respect to space development, people concerned with national experimental research institutions that are involved in space development and utilization are being sent to research organizations of foreign countries advanced in space development.

Qualified applicants are: 1) up to 35 years of age, 2) university graduates or people having at least the equivalent specialized knowledge, 3) government personnel periodically engaged in work or research having to do with the promotion of space development and utilization for at least 2 years prior to being sent abroad.

Researchers that will be sent abroad are selected from individuals recommended by any of the ministries and agencies. Decisions on who will be sent are made after giving candidates foreign language tests and oral examinations on subjects such as research objectives, problems, and the state of affairs at the foreign destination organization. In FY 1988, 8 people were sent abroad as space-development-related research personnel.

(From the Space Development Division of the Research and Development Bureau)

### (6) Overseas S&T Research Personnel System

With the promotion of S&T as the objective, researchers and other personnel have been sent abroad since 1956.

Scientific and technological research workers sent abroad are primarily researchers from experimental research institutes affiliated with any of the ministries and agencies, except for the Defense Agency and the Ministry of Education, Science and Culture. Expenses incurred in sending a researcher overseas are appropriated as overseas researcher travel expenses in a lump sum from S&T promotion funds by the agency involved.

#### 1) Long-Term Foreign Resident Researchers

For researchers sent overseas to conduct experimental research for one year in foreign universities and experimental research institutions, candidate recommendations are requested from each of the ministries and agencies. The final decision on whether a candidate will be sent or not is made after a selection interview is conducted on the subject of the candidate with respect to foreign language, research objectives, and problems, and the state of affairs at the foreign destination organization.

Qualified applicants are: 1) employed in experimental research institutes affiliated with any of the ministries and agencies except for the Defense Agency and the Ministry of Education, Science and Culture; 2) university graduates, graduates of old-system specialized schools, or people having at least the equivalent specialized knowledge; 3) engaged in experimental research work for at least 3 years; 4) up to 35 years of age.

#### 2) Mid-Term Foreign Resident Researchers

For researchers sent overseas to conduct investigative research for a period of 1 - 6 months in foreign universities and experimental research institutions, recruiting is the same as that for long-term foreign resident researchers. Records of the individual recommended by any of the ministries or agencies are used in selecting and deciding whether that person will be sent abroad or not.

Qualified applicants are: 1) employed in experimental research institutes affiliated with any of the ministries and agencies except for the Defense Agency and the Ministry of Education, Science and Culture; 2) university graduates, graduates of old-system specialized schools, or people having at least the equivalent specialized knowledge; 3) engaged in experimental research work for at least 7 years; 4) up to 35 years of age.

#### 3) Partly Guaranteed Researchers

For government employees engaged in experimental research (excluding those connected with the Defense Agency or the Ministry of Education, Science and Culture) who have passed foreign government or university examinations, or for those whose achievements are recognized through research thesis exchange with a foreign research institute, if the research contents are judged to be useful in promoting S&T, one-way or roundtrip airfares are provided for researchers conducting experimental research overseas for 6 months to one year in the case where the researcher receives financial assistance from a foreign government or university.

#### 4) Researchers Sent to International Research Meetings

Since FY 1968, the trail has been broken for sending researchers to international research meetings. The type of meetings are those that are sponsored by powerful S&T research organizations and groups, meetings in which limited numbers of researchers hold discussions on specific topics. To qualify for being sent to one of these meetings, a government research employee must have been engaged for at least three years in research work in the specialized field that a particular meeting is about. The decision on who will be sent to a meeting is based on a requested recommendation from any of the ministries and agencies and the records of the candidate.

#### 5) Japan-USSR Cultural Exchange Researchers

Based on the researcher exchange agreement reached in FY 1987, exchanges between scholars and researchers are taking place based on the principle of mutualism between Japanese government research organizations and Soviet research organizations.

#### 6) Two-Country Cooperation that Involves Sending Specialists

In the system implemented since FY 1977, specialists are dispatched when necessary in two-country cooperative situations. However, specialists affiliated with the Defense Agency or the Ministry of Education, Science and Culture or those engaged in experimental research in social science are excluded.

(From the International Cooperation Division of the Science and Technology Promotion Bureau)

### (7) Holding the S&T Forum

#### 1 Summary

A forum on S&T, based on the fundamental policies of the Council for Science and Technology Policy Committee, was held from 26 January 1989 (Thursday) to 28 January 1989 (Saturday) with the unified theme, "The Future Image of Leading-Edge Science and Technology—Seeking New Research Possibilities."

The aims of this S&T forum were, through the free exchange of ideas between researchers, to contribute to mutual intellectual contact detonation and to probe the possibilities and direction of development, now and in the future, in leading-edge S&T fields. In doing so, the forum was meant to affect S&T policies. This was the eighth forum that was held since its inception in 1981. A total of 56 researchers, 38 domestic researchers and 18 overseas researchers, from the front lines of a wide range of fields, participated in the forum.

In this forum, individual discussion themes were not initially fixed, but six Different Field Exchange Subcommittees, formed by about 10 researchers, worked on selecting concrete themes.

In the Different Field Exchange Subcommittees, participating researchers introduced themselves, then explained their research themes and the prospects for their fields in the years 2000 to 2010, accepted questions and conducted discussions about these topics. Themes for separate subcommittees-classified-by-theme were proposed.

**2 Subcommittees-Classified-by-Theme Discussions**

In the subcommittees-classified-by-theme of the later half of the forum, lively discussions were held on the following five themes.

**(1) Simulation**

Accompanying the dramatic rise in the capabilities of computers in recent years, simulation is being applied as an effective research resource in various fields. At the same time, experimentation for the purpose of obtaining concrete data is also used as an important research resource. For advances in research both now and in the future, methods which aptly combine simulation and experimentation are thought to be preponderant. For these reasons, research in the years 2000 to 2010 was taken into account and discussions were held about the current state of simulation, its problems, and its connection with experimentation.

**(2) Entertainment Technology**

As one of the directions to be taken in the utilization of S&T, there is the pursuit of comfort and psychological richness in the human lifestyle, and it is expected that value will come to be placed more and more on that which is easy, enjoyable, safe, and intellectual. Based on the proposal that this kind of technology be thought of as entertainment technology, discussions were held on the way this technology should be and the R&D directions for attaining that ideal.

**(3) 21st Century Neurobotics**

When it came time to survey the robot of the 21st century, with the viewpoint of a more lifelike robot, the general idea of neurobotics (neuron plus robotics) was proposed. To further R&D for this kind of robot, converstational communications technology, vision and artificial intelligence, neural circuit networks, navigational technology, drive mechanisms, and energy sources are necessary. Problems with these and other areas and the robot that is expected in the 21st century were discussed.

**(4) Interactions between Neural Science and Leading-Edge Technology**

Accompanying the advances in leading-edge technology, it is anticipated that the computers of the future will start to incorporate the results of neural science. There is also the expectation that progress in biotechnology that uses leading-edge technology will shed light upon the brain and neural circuit networks of man.

Discussions were held on research in computers, which are representative of leading-edge technology; brain and nervous system research; and, because there are similarities with numerical processing, and because progress in neural science analysis depends on advancements in computers, the questions of how mutual contributions can be made in neural science and leading-edge technology and how new development can be worked towards in the respective fields.

**(5) Building New Systems Modelled on Living Organisms and the Applications**

Great advancements are foreseen in the applications of fields such as recognition mechanisms in living organisms, and elucidating the interactions between living cells and materials, medical materials, and pharmaceuticals. Biodevices and biocomputers are expected in the field of electronics. Neural computers that incorporate the results of neural science are also gaining a great deal of attention because logic that has until now been difficult to realize is possible. There are many aspects of living organisms that should be studied in these ways, and because the range of applications is broad, building new systems modelled on living organisms and how to apply those systems were discussed.

(From the Resources Room of the Policy Division of the Science and Technology Policy Bureau)

**Holding the National Research Institute Exchange Promotion Meeting**

On 7 December 1988, about 160 heads of the country's national experimental research institutions, research institutes of public corporations, industry and universities convened at the National Research Institute Exchange Promotion Meeting. This meeting was sponsored by the Science and Technology Agency and was held at the Science and Technology Agency Research Exchange Center.

In looking at the importance of the role played by experimental research institutions in the promotion of our country's S&T, the purposes of this meeting were to intensify mutual cooperation among industrial, university, and government experimental research institutions; to encourage exchange; to encourage exchange of information on institution management; to invigorate research activities in our country's experimental research institutions; and to contribute to the present and future development of S&T policies.

In the 1988 National Research Institute Exchange Promotion Meeting, lectures and panel discussions on the topic "Facing New Development in Industrial, University, and Governmental Cooperation" were conducted.

(From the Research and Development Cooperation Division of the Science and Technology Promotion Bureau)

## Chapter 3. Promoting Research with the Coordination Funds for Promoting Science and Technology

### 1. About the Coordination Funds for Promoting Science and Technology

The Coordination Funds for Promoting Science and Technology were set up in FY 1981 along the guidelines set forth by the Council for Science and Technology (CST). These funds are used for the comprehensive coordination of important research work needed for scientific and technological development.

The CST established the "Basic Policy on Utilization of the Funds for Promoting Science and Technology" (March 1981, revised in November 1984) and has been given the job of using the following six items as a basis in applying the funds:

1) Promoting leading-edge and basic research
2) Promoting R&D that requires cooperation among a number of research institutes
3) Strengthening the coordinated cooperation between industry, universities, and the government
4) Promoting international joint research
5) Having the flexibility to respond with the appropriate research in an emergency situation
6) Implementing research assessments and conducting R&D surveys and analyses

In view of the importance of the responsibilities which our country must assume in the area of fundamental research, we have been striving to promote priority, fundamental research in the national experimental research institutions since FY 1985. Also, in looking at the importance of international exchange in the promotion of S&T, we have been working on promoting individual, important, international joint research efforts since FY 1986.

Additionally, in view of the importance of international and interagency fundamental research in national research and in the international exchange of researchers, we have been striving to promote internationally fluid fundamental research since FY 1988.

Regarding application of the funds in FY 1988, the report entitled "On the Concrete Application of the Coordination Funds for Promoting Science and Technology" was decided upon by the Policy Committee of the Council for Science and Technology on 14 April 1988. The guidelines indicated in this report focused on the the promotion of fundamental and leading-edge S&T fields, with priority given especially to promotion of substance and materials S&T and life science fields; coping with earth S&T was also given consideration. Along these lines, intermittently occurring research subjects from FY 1987 were added, six research subjects were newly implemented, and four subjects for investigation and four research subjects for coping in a mobile manner with emergency situations throughout the fiscal year were established. Table 1-3-1 shows these in concrete terms.

**Table 1-3-1. FY 1988 Implementation of Coordination Funds for Promoting Science and Technology**

I. Promotion of fundamental and leading-edge S&T.....4,439

1. Priority promotion fields.....3,829

(i) Substance and materials S&T.....1,977

(Unit: ¥1 million)

| Subject | Term | Organization(s) Implemented By | Funds Needed in FY 1988 |
|---|---|---|---|
| (1) Basic technology research for creating new materials using hybrid structure design technology | 1987-89(2nd term) | STA, MITI, universities, private organizations | 105 |
| (2) Output-power and wavelength-variable lasers and laser processing technology research | 1987-89(2nd term) | STA, MITI, universities, private organizations | 123 |
| (3) Ultrahigh-temperature generation, measurement, and utilization technology research | 1985-87(1st term) | STA, MITI, Ministry of Transport, Ministry of Posts and Telecommunications, universities, private organizations | 203 |
| (4) Research on evaluation and analysis technology using new beams for high-performance functional materials | 1986-88(1st term) | STA, MITI, Ministry of Posts and Telecommunications, universities | 335 |
| (5) Research on basic technology for creating new functions by rare metal superpurification | 1987-89(1st term) | STA, MITI, private organizations, local public groups | 253 |
| (6) Research on basic technology with which to develop functionally gradient materials for thermal stress and relaxation | 1987-89(1st term) | STA, MITI, Ministry of Transport, universities, private organizations | 308 |
| (7) Ultrahigh vacuum generation, measurement, and utilization technology research | 1988-90(1st term) | STA, MITI, universities, private organizations | 245 |

**Table 1-3-1. FY 1988 Implementation of Coordination Funds for Promoting Science and Technology (Continued)**

I. Promotion of fundamental and leading-edge S&T.....4,439

1. Priority promotion fields.....3,829

(i) Substance and materials S&T.....1,977

(Unit: ¥1 million)

| Subject | Term | Organization(s) Implemented By | Funds Needed in FY 1988 |
|---|---|---|---|
| (8) Vacuum UV light generation and utilization technology research | 1988-90(1st term) | STA, MITI, universities | 277 |
| (ii) Life sciences.....380 | | | |
| (1) Functional protein analysis, modification, and imitation technology research | 1986-88(2nd term) | STA, MITI, Ministry of Health and Welfare, universities, private organizations | 101 |
| (2) Development of common basic technology to support cancer research | 1987-89(2nd term) | STA; Ministry of Agriculture, Forestry and Fisheries; universities; private organizations; local public groups | 263 |
| (3) Development of basic technology for elucidating brain functions | 1985-1987(1st term) | STA, MITI, Ministry of Health and Welfare, universities, private organizations | 245 |
| (4) Development of chromosome analysis and utilization technology | 1985-1987(1st term) | STA; MITI; Ministry of Finance; Ministry of Health and Welfare; Ministry of Agriculture, Forestry and Fisheries; MITI; universities; private organizations | 168 |
| (5) Research on basic technology for utilization of bio-energy conversion functions | 1986-88(1st term) | STA; MITI; Ministry of Agriculture, Forestry and Fisheries; universities; private organizations | 165 |
| (6) Development of basic technology for elucidating immune response mechanisms | 1987-89(1st term) | STA; Ministry of Agriculture, Forestry and Fisheries; Ministry of Health and Welfare; universities; private organizations; local public groups | 438 |
| (7) Development of developmental engineering technology | 1988-1990(1st term) | Ministry of Agriculture, Forestry and Fisheries; Ministry of Health and Welfare; universities; private organizations | 189 |
| (8) Development of technology for highly sensitive and analytical non-destructive measurements at the biomolecular level | 1988-1990(1st term) | Ministry of Health and Welfare; Ministry of Agriculture, Forestry and Fisheries; universities; private organizations | 175 |
| (9) Fundamental research on recombinant DNA open systems safety | 1988-1990(1st term) | Environment Agency; Ministry of Finance; Ministry of Health and Welfare; Ministry of Agriculture, Forestry and Fisheries; MITI; local public groups; universities; private organizations | 108 |
| (iii) Other.....863 | | | |
| (1) Research on knowledge-based systems to support chemical substance design | 1986-88(1st term) | STA; Ministry of Health and Welfare; Ministry of Agriculture, Forestry and Fisheries; MITI; universities; private organizations | 282 |
| (2) Development of technology for effective utilization of deep sea resources | 1986-88(1std term) | STA; Ministry of Health and Welfare; Ministry of Agriculture, Forestry and Fisheries; Ministry of Transport; MITI; universities; local public groups | 329 |
| II. Promotion of strong R&D to meet national and social needs.....627 | | | |
| (1) Research on earthquake tectonics in active areas of Central Japan | 1988-1990(2nd term) | STI, MITI, Ministry of Transport, Ministry of Construction, private organizations | 159 |
| (2) Development of landslide disaster prediction systems | 1986-88(1st term) | STA; Ministry of Agriculture, Forestry and Fisheries; MITI; Ministry of Construction; Ministry of Transport | 45 |
| (3) Research on predicting magnitude-7-class continental earthquakes | 1987-1989(1st term) | STA, MITI, Ministry of Construction, Ministry of Transport, Ministry of Posts and Telecommunications, private organizations | 267 |
| III. Positive promotion of international joint research.....1,021 | | | |
| (1) International joint research on evaluation technology for new materials experimentation | 1986-88(1st term) | STA, MITI, Ministry of Transport, universities, private organizations, local public groups | 144 |
| (2) Joint research with ASEAN countries on advancements in remote sensing technology and its applications | 1986-88(1st term) | STA; Environment Agency; Ministry of Agriculture, Forestry and Fisheries; MITI; Ministry of Construction; private organizations; local public groups | 100 |

**Table 1-3-1. FY 1988 Implementation of Coordination Funds for Promoting Science and Technology (Continued)**

I. Promotion of fundamental and leading-edge S&T.....4,439

1. Priority promotion fields.....3,829

(i) Substance and materials S&T.....1,977 (Unit: ¥1 million)

| Subject | Term | Organization(s) Implemented By | Funds Needed in FY 1988 |
|---|---|---|---|
| (3) Elucidation of the Pacific plate formation region (rift system) in the South Pacific Ocean | 1987-1989(1st term) | STA, Environment Agency, Ministry of Transport, MITI, universities, private organizations | 227 |
| (4) International joint research on climatic fluctuations and Pacific atmospheric and oceanic fluctuations | 1987-1989(1st term) | STA; Environment Agency; Ministry of Agriculture, Forestry and Fisheries; MITI; Ministry of Transport; Ministry of Posts and Telecommunications; universities | 310 |

In addition, implementation of other individual, important international joint research.

IV. Internationally fluid fundamental research.....300

| | | | |
|---|---|---|---|
| (1) Basic research on earthquake damage and wave propagation in heterogeneous structures | 1988-90 | Haruo Sato, Head of Crustal Fluctuation Research at the STA's National Disaster Prevention Science and Technology Center | 37 |
| (2) Research on macrocluster melted liquid structures and their effects on crystal formation | 1988-90 | Shigeyuki Kimura, General manager of the 13th Research Group at the STA's Inorganic Materials Research Institute | 38 |
| (3) Research on new physiological agents using transgenic plants | 1988-90 | Koichiro Shinomura, Head of Breeding Physiology Research at the Ministry of Health and Welfare's National Medical Experimentation Institute | 38 |
| (4) Elucidation of varietal singularities in cell omnipotence distribution factors | 1988-90 | Kiyoharu Ono, Head of Cell Information Research at the Ministry of Agriculture, Forestry and Fisheries' Agricultural Bioresources Research Institute | 36 |
| (5) Research on protein factors in genetic transfer control in connection with producing plant characteristics | 1988-90 | Chikafusa Fukuzawa, Head of Functional Microbiological Engineering Research at the Ministry of Agriculture, Forestry and Fisheries' Comprehensive Food Research Institute | 37 |
| (6) Precision laser ranging technology research | 1988-90 | Tadayoshi Oishi, Manager of the Quantum Division at MITI's Measurment Research Institute | 35 |
| (7) Chemical research on atmospheric fluctuations in the troposphere and lower stratosphere | 1988-90 | Yukio Sugimura, Head of the Earth Chemistry Research Department of the Ministry of Transport and the Meteorological Agency's Meteorological Research Institute | 40 |
| (8) Limit decomposition light imaging technology research | 1988-90 | Tadashi Ariga, Head of space development research at the Ministry of Posts and Telecommunications' Comprehensive Research Institute | 38 |

The third column shows the core national research leaders.

V. Promotion of fundamental research in the national experimental research institutions.....1,351

VI. Promotion of surveys and analyses.....318

| | | | |
|---|---|---|---|
| (1) Surveys on prospects for interdisciplinary research fields and leading-edge S&T development directions | 1974-1987 | STI, private organizations | 57 |
| (2) Surveys on trends in human and investment resources and information distribution for contributing to the smooth promotion of S&T activities | 1985-1987 | Private organizations | 36 |
| (3) Surveys of environmental condition maintenance for promoting fundamental pioneering research | 1987-1989 | MITI, private organizations | 44 |
| (4) Surveys and investigations into possibilities for the international fundamental research program idea | 1986-1988 | Private organizations | 211 |

**Table 1-3-1. FY 1988 Implementation of Coordination Funds for Promoting Science and Technology (Continued)**

I. Promotion of fundamental and leading-edge S&T.....4,439

1. Priority promotion fields.....3,829

(i) Substance and materials S&T.....1,977

(Unit: ¥1 million)

| Subject | Term | Organization(s) Implemented By | Funds Needed in FY 1988 |
|---|---|---|---|
| (5) Surveys on measurement and control technology for elemental functions occurring in ultrasmall domains of substances and materials | 1988 | Private organizations | 10 |
| (6) Surveys on elucidating the mechanisms that cause deserts to spread | 1988 | Private organizations | 2 |
| (7) Surveys on database construction for superconductor R&D | 1988 | Private organizations | 10 |
| (8) Surveys on scientific elucidation of Far Eastern medicine | 1988 | Private organizations | 11 |
| VII. Critical Research and Mobile International Response....351 | | | |
| (1) Critical research on provisional screening for the development of freon substitutes | 1988 | MITI, private organizations | 46 |
| (2) Critical research on isolating the geneological groups of Alaska Pollack resources in the Bering Sea | 1988 | Ministry of Agriculture, Forestry and Fisheries, private organizations | 35 |
| (3) Critical research on the current state of and future topics in the distribution of S&T information in Japan and the US | 1988 | Private organizations | 29 |
| (4) Critical research on the safe, comfortable utilization of deep underground spaces | 1988 | Environment Agency; Ministry of Construction, Ministry of Health and Welfare, Ministry of Posts and Telecommunications, Private organizations | 33 |

In addition, implementation of ther critical consignment research.

## 2. Newly Established Research and Survey Subjects Using the Coordination Funds for Promoting Science and Technology

### (1) New Subjects in FY 1988

In FY 1988, the following six research and four survey subjects were newly established.

#### 1) New Research Subjects

A. Ultrahigh vacuum generation, measurement, and utilization technology research

In order to establish ultrahigh vacuum generation, measurement, and utilization technology, elemental technology which is indispensable to the development of artificial super-lattice devices and other new materials, research will be conducted in 1) improving the performance of vacuum pumps, 2) elucidation of gas release mechanisms, 3) development of low gas release materials, 4) development of drive mechanisms, and 5) development of ultrahigh vacuum measurement technology.

B. Vacuum UV light generation and utilization technology research

Because vacuum UV light wavelengths (0.2 - 200 mm) are expected to be the basis for advancement in a wide range of leading-edge S&T fields, such as substance and materials, information and electronics, and the life sciences, research will be comprehensively conducted in 1) the development of vacuum UV light generation technology, 2) the development of optical devices, 3) the fundamental technology (measurement, chemical synthesis) for the utilization of vacuum UV light.

C. Developmental engineering technology research

In order to establish the fundamental technology of developmental engineering, the goals of which are the individual design, construction and utilization of useful plants and animals, research will be conducted in 1) technology that manipulates the functions of genes introduced into developmental phase cells; 2) technology that reconstructs the individual and the structure by manipulating omnipotent, versatile cells; 3) developmental engineering utilization technology, such as technology for making useful domestic animals and experimental models for use in aging research.

D. Research on the development of technology for highly sensitive and analytical non-destructive measurements at the biomolecular level

To develop basic measurement technology, which does not damage living organisms at the molecular level, for elucidating the advanced life activity mechanisms exhibited in the structures and materials of living organisms, research will be conducted on 1) the development of optical-technology-based realtime measurement technology and 2) the advancement of NMR technology.

E. Fundamental research on recombinant DNA open systems safety

To establish the technology for evaluating and managing the safety of recombinant DNA technology, which is expected to be used in open systems such as agricultural and environmental conservation, development work will be carried out in 1) risk assessment technology for evaluating and measuring the effects of recombinant DNA on living organism systems, and 2) risk management technology for preventing ill effects of recombinant DNA.

F. Research on advancing the technology for coping with deep snowfalls

To shed light on the phenomenon of snow and to improve the lifestyle and environment in snowbelt areas, 1) fundamental research, that uses the latest observation technology, on elucidating the snowfall mechanism and 2) development of efficient snow removal technology based on snow-handling technology that uses terrestrial heat and snow transport management will be carried out.

**2) New Survey Subjects**

A. Surveys on measurement and control technology for elemental functions occurring in ultrasmall domains of substances and materials

Regarding elemental functions, which are the fundamental physical properties of the smallest units of substances and materials, 1) elemental function measurement technology and 2) evaluations of elemental functions in materials will be surveyed, and 3) surveys will be carried out to clarify the current problems with structure and elemental function control and the directions of R&D promotion both now and in the future.

B. Surveys on elucidating the mechanisms that cause deserts to spread

To contribute to the prevention of the spread of deserts, which is a global-scale problem, surveys will be conducted to 1) determine the actual state of the spread of desert lands and measures for preventing the spread, 2) shed light on the mechanisms which cause deserts to spread, and 3) with respect to international joint research systems, to clarify the current problems and the directions of R&D promotion both now and in the future.

C. Surveys on database construction for superconductor R&D

In connection with building a database for the development of superconducting materials, surveys will be conducted on 1) metadata unique to superconducting substances, 2) database utilization technology to support superconducting substance and materials design.

D. Surveys on the scientific elucidation of Far Eastern medicine

Far Eastern medicine, which has come to be recognized as effective in treating all the diseases of oldage, will be surveyed, with all individual patients as the subject, to 1) determine the current state of research on this subject, and 2) shed scientific light on its practice.

**(2) Research Subjects of 2nd Term Plans Begun in FY 1988**

Among the intermittently occurring research subjects from previous years, second term plans commenced for the following four subjects, based on the results of evaluations by the Research Evaluation Subcommittee.

A. Ultrahigh-temperature generation, measurement, and utilization technology research

Because material creation technology that uses ultrahigh temperatures (4,000 - 10,000 °C) is attracting attention, basic technology for developing materials with new functions will be established. Research will be conducted on 1) the creation of new materials using high-concentration, high-frequency hot plasma, 2) the creation of new materials using high-frequency hot plasma that has large reaction sites, and 3) measurement technology for use in ultrahigh temperature reaction sites.

B. Development of basic technology for elucidating brain functions

To contribute to rapid advancements in brain function and related technology research, which is hoped for in order to bring about developments in the life sciences, for certain, and in a wide range of other S&T fields such as information and electronics S&T as well, research will be conducted on 1) the development of technology for analyzing brain functions using molecular biology techniques, 2) the development of technology for analyzing brain functions using imaging, and 3) brain function model construction methods.

C. Research on the development of chromosome analysis and utilization technology

To contribute to the analysis of chromosomal functions and structures that support higher life phenomena in eucaryotes, the creation of new plants and animal breeds, and the production of useful substances, development will be carried out in 1) chromosome separation and refinement technology, 2) technology for analyzing the physical and functional structure of chromosomes, and 3) chromosome function technology.

D. Research on earthquake tectonics in active areas of Central Japan

To elucidate the ways in which earthquakes occur in Central Japan and nearby coastal areas from the standpoint of large-area crustal movements, research will be conducted on 1) earthquake tectonics of the eastern Japan Sea coastal area and areas close to the Fossa Magna, 2) earthquake tectonics of the areas in the vicinity of the points where the continental plates meet, 3) earthquake tectonics of the areas in the vicinity of the points where three coastal plates meet, and 4) general earthquake tectonics.

### (3) Critical Research in FY 1988

In order to cope in a mobile fashion with the occurrence of urgent situations during the 1988 fiscal year, the following four research subjects were established.

A. Critical research on provisional screening for the development of freon substitutes
   Because there have been international attempts, based on the seriousness of the damage to the ozone layer, to rapidly intensify regulations concerning freon, research will be carried out to sample freon substitute candidates and evaluate freon substitutes by measuring their physical properties.
B. Critical research on isolating geneological groups of Alaska Pollack resources in the Bering Sea
   Because the Bering Sea is the only bottom seining area for Alaska Pollack that is left to our country, research on isolating the geneological groups that this resource belongs to will be conducted for the purposes of establishing scientific management and, in preparation for future international negotiations, for clarifying the origin of pollack resources in fishing areas that come into question during negotiations.
C. Critical research on the current state of and future topics in the distribution of S&T information in Japan and the US
   The new Japan-US Science and Technology Cooperation Agreement pointed out the imbalance in the distribution of information between Japan and the US and the insufficiency of information about government-supported R&D planning in both countries. Because of the urgent demands for elucidation of the actual state of affairs, surveys will be conducted on the current state of international distribution of S&T information in Japan and the US and its problems, and also on the grasp of the current state of America's government-supported R&D planning.
D. Critical research on the safe, comfortable utilization of deep underground spaces
   Because of the attempts to rapidly promote the accelerated utilization of deep underground spaces, in the context of sudden jumps in land prices during the last few years, surveys will be conducted on the systematization of S&T related to the utilization of deep underground spaces and the direction of that development, both now and in the future; and the establishment of common, basic technical environmental and disaster prevention needed for the safe and comfortable utilization of deep underground spaces.

## Chapter 4. The International Frontier Research System

### 1. Background Behind the Start of the International Frontier Research System

Science and technology has shown remarkable progress and has contributed to the progress of society and the economy, but, in recent years, the discoveries of important new knowledge that supports science and technology have been stagnating and the progress of S&T is running into a dead end. In order to maintain the advancement of S&T both now and in the future, discoveries of scientific knowledge at a more basic level, that will prove to be the sources of innovative technologies, are indispensable.

Until now, the social and economic growth in Japan has been based on the introduction of fundamental research results from Europe and the US. But, as a consequence of the rise in our country's international status, we are now emerging from the catch-up type of behavior, and it is our duty to contribute to the world by playing a leading role in the discovery of new scientific knowledge.

In this way, it is vitally important that our country work towards discoveries of new scientific knowledge and go to meet the challenges of leading-edge fundamental research. By going beyond the systems of existing research organizations, by gathering together researchers from many fields, and by an internationally open system, the International Frontier Research System, which was inaugurated in October 1987, aims at aggressively uncovering the kind of new scientific knowledge that will become the basis of technological reform in the 21st century.

### 2. Overview of the International Frontier Research System

#### (1) Organization Outline

Although the International Frontier Research System is an internal organization of the Institute of Physical and Chemical Research, its management mode differs from the norm. There are three research fields and ten research teams under the direction of the chief of the system.

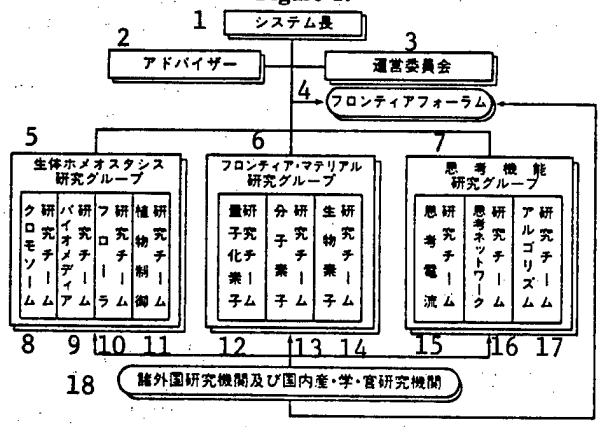
#### (2) Features

The International Frontier Research System is not only fluidly managed but also is an internationally open system with the following features: 1) a research system that pools research capabilities from various fields; 2) an internationally open research system; 3) long-term research based on a fluid researcher system; 4) actively makes the most of young researchers; 5) opens up new areas of knowledge that are backed by experimentation; 6) establishes a free and generous atmosphere conducive to original thinking.

#### (3) Research Fields and the Budget

To discover new scientific knowledge, the new Thought Functions Research Group was started in October within the International Frontier Research System, which is now carried out in the following three fields. (The FY 1988 budget was ¥1.515 billion.)

Figure 1.




Key:—1. Chief of system—2. Advisors—3. Steering committee—4. Frontier forum—5. Bio-homeostasis research group—6. Frontier materials research group—7. Thought functions research group—8. Chromosome research group—9. Bio-media research group—10. Flora research group—11. Plant control research group—12. Quantization device research group—13. Molecular device research group—14. Bio-device research group—15. Thought current research group—16. Thought network research group—17. Algorithm research group—18. Foreign research institutes and Japanese industrial, university, and governmental research institutions

**(i) Animal and plant bio-homeostasis research fields focused on the aging process**

In anticipation of applications in a broad range of fields, such as controlling aging to cope with the longer-living society of the 21st century and creating plants that can adapt to arid and other kinds of environments, efforts will be made to explain the mechanisms of the functions that preserve physiological balance in such a way that there is no deviation from the constant normal state (homeostasis: the function that maintains constancy in living organisms).

**(ii) Fields of research on materials that have new functions (frontier materials)**

In anticipation of the creation of frontier materials (such as new functional devices), which will become the foundation for new age information science, efforts will be made to elucidate the various phenomena brought about by cells, proteins and other biological molecules, polymers, ultramicroscopic states of metals and other substances, and combinations thereof.

**(iii) Fields of research on thought functions of the brain**

Using anatomical, physiological, and logical methods, efforts will be made to explain the organization and principles of the brain, knowledge which will become the foundation for new-age information science, behavioral science, and other areas of S&T.

## Chapter 5. Promoting Creative S&T

### 1. Outline of the Creative S&T Promotion System

In recognizing the importance of our country's active endeavors, both now and in the future, in the search for scientifc and technological seeds that will become the wellspring of technological innovation, the Science and Technology Agency established the System for the Promotion of Creative Science and Technology within the Research Development Corp. in October 1981, building upon the March 1981 decision of the Council for Science and Technology.

The System for the Promotion of Creative Science and Technology gives consideration to ensuring creativity, and, by virtue of its being based on continued regard for relationships with existing research organizations, it attempts to promote efficient investigative research for innovative technological seeds.

(i) Excellent research leaders are appointed as general managers. The general manager has a certain level of discretionary power in managing the research and, within those bounds, works towards comprehensively promoting research.
(ii) Excellent, young research personnel, inflamed with the creative desire, are recruited from industry, universities, the government, and abroad and are organized into research groups.
(iii) On the condition that the researcher either retains his employment with the research institute from which he hails or that he be free to return to his position with his former employer, the researcher participates in a fixed-period (five years) research project. When the research is completed, the research group is disbanded.
(iv) In promoting research projects, development of research subjects for the purpose of making the most of researchers' creativity will be emphasized. Priority will be given to bringing out unexpectable discoveries and inventions, and flexible management will be carried out so that research objectives can be easily changed during the research process.
(v) Consideration will be given to incentives that serve to encourage enthusiastic participation by researchers from industry, universities, the government, and, especially, private organizations.

### 2. Outline of Research Projects

1) In the System for the Promotion of Creative Science and Technology, attention is given to several basic areas that lie between materials, on one hand, and life, on the other. Concrete project themes involving the research subjects of the areas established, where the creation of innovative technology is highly possible, will be chosen. These research subject areas are as follows.

Materials
Materials area
Material to material conversion area
Material and material interaction area
Material and energy interaction area
Information area that spans across materials and life
Life area
Human area
Life

2) In this system, the term of a research project is five years long, the total research operating expenses for each project amount to approximately ¥2.0 billion, and the standard scale of manpower is about 20 researchers for each project. In the first year, FY 1981, the "Superfine Grains," "Special Structure Materials," "Fine Polymers," and "Perfect Crystals" projects were started; in FY 1982, the "Bioholonics" project; in FY 1983, the "Biological Information Transmission" project; in FY 1984, the "Special Environment Microbiological Organisms" project; in FY 1985, the "Nano Mechanism" and "Solid Surfaces" projects; in FY 1986, the "Magnetic Flux Quantum Information," "Ultraparticle Flexible Structure," and "Biological Photon" projects; in FY 1987, the "Terahertz," "Generative Genes," and "Chemical Organization" projects; and, in FY 1988, the "Quantum Waves," "Microscopic Conversion," and the "Plant Information Substances" projects.

Now and in the future, too, new projects will be inaugurated every fiscal year and, one after another, new research projects will be tackled.

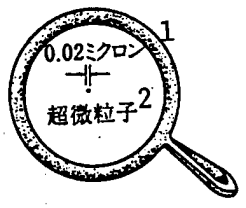
The budgets for each research project are given in Table 1-5-1.

**Research Project Budgets (Unit: ¥1 million)**

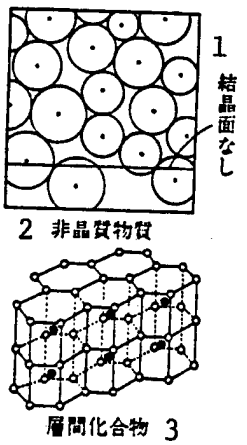
| Research Project | FY 1987 Budget | FY 1988 Budget | Remarks |
|---|---|---|---|
| 1 Superfine Grains | - | - | Projects ended in September 1986 |
| 2 Special Structure Materials | - | - | " |
| 3 Fine Polymers | - | - | " |
| 4 Perfect Crystals | - | - | " |
| 5 Bioholonics | 160 | - | Project ended September 1987 |
| 6 Biological Information Transmission | 359 | 173 | Project ended September 1988 |
| 7 Special Environment Microorganisms | 367 | 281 | 5-year research term |
| 8 Nano Mechanism | 381 | 406 | |
| 9 Solid Surfaces | 402 | 405 | |
| 10 Magnetic Flux Quantum Information | 427 | 395 | |
| 11 Ultraparticle Flexible Structure | 445 | 302 | |
| 12 Biological Photon | 565 | 335 | |
| 13 Terahertz | 99 | 439 | |
| 14 Generative Genes | 132 | 404 | |
| 15 Chemical Organization | 102 | 375 | |
| 16 Quantum Waves | - | 101 | Projects begun in October 1988 |
| 17 Microscopic Conversions | - | 99 | " |
| 18 Plant Information Substances | - | 101 | " |
| | 3,439 | 3,816 | |

1 Superfine Grains
(a) Person in general charge: Chikara Hayashi, President of the Ulvac Corp.
(b) Outline
This work involves searching for the properties of extremely fine metallic particles, whose sizes are on the order of one-tenth of the length of a virus. The objective is development that will have applications in a wide range of fields such as magnetic materials, superconducting materials, chemical reaction catalysts, and virus isolation materials.
(c) Research themes: basic properties, physical applications, biological and chemical applications, and generative methods.

2 Special Structure Materials
(a) Person in general charge: Ken Masumoto, Tohoku University professor
(b) Outline
Objectives are: the design and synthesis of materials having special atomic structures such as that of inter-layer compounds and non-crystalline metals; and the creation of new materials such as heretofor nonexistent magnetic materials, optoelectric conversion materials, corrosion-resistant materials, and hydrogen absorbing metals.




Key: 1. 0.02 microns—2. superfine grain




Key:—1. no crystal surface—2. non-crystalline material—3. inter-layer compound material

(c) Research themes: basic properties, non-crystalline compound materials, non-crystalline thin film materials, special ceramic materials, and inter-layer compound materials.

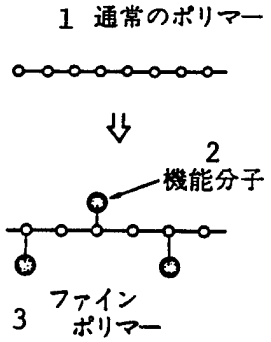
3 Fine Polymers

(a) Person in general charge: Naochika Ogata, Uechi University professor

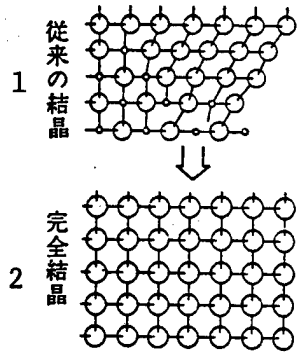
(b) Outline

This work involves the design and synthesis of high-value-added polymers endowed with special functions, such as polymer selective absorptivity and conductivity, and searching for applications in the selective absorption of specific substances, separation materials, conductive materials, and super-high-strength lightweight materials.

(c) Research themes: molecular design, materials with selective functionality, and organic electronic materials




Key:—1. ordinary polymer—2. function atom—3. fine polymer




Key:—1. conventional crystal—2. perfect crystal

4 Perfect Crystals

(a) Person in general charge: Junichi Nishizawa, Tohoku University professor

(b) Outline

Objectives are: to extract the superb characteristics of electrostatic device elements, which have been touted as the promising devices of the next generation, through the use of materials with perfect crystalline structures having no distortions; applications as devices in high-performance computers, high-capacity rectifiers, and optically functional devices.

(c) Research themes: basic structure, super-highspeed devices, perfect crystal formation methods, optically functional devices

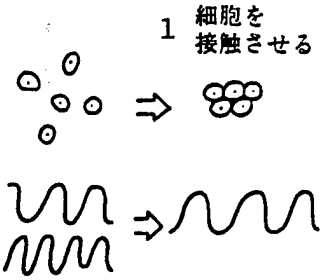
5 Bioholonics

(a) Person in general charge: Denichi Mizuno, Tokyo University professor

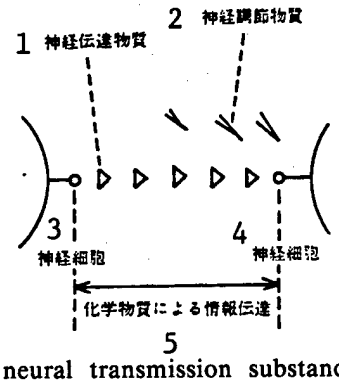
(b) Outline

Objectives are: continued elucidation of the basic properties of holonics systems within living organisms; creation of self-organizing systems from mutually cooperative elements and arrays of these elements; ultrasmall molecular machinery; high-efficiency information transmission routes; applications in technology for the treatment of diseases such as arteriosclerosis.

(c) Research themes: basic design, structure, and control




Key:—1. bringing the cells into contact with each other




Key:—1. neural transmission substance—2. neural adjustment substance—3. nerve cell—4. nerve cell—5. information transmission by chemical substances

6 Biological Information Transmission

(a) Person in general charge: Osamu Hayaishi, dean of Osaka Medical College (property) Osaka Bioresearch Institute

(b) Outline

This work continues to elucidate the information transmission mechanisms at the molecular level in the nervous system, searches for pharmaceutical treatments and preventive methods for nervous and mental diseases, and can be useful for innovation in new information processing technology.

(c) Research themes:

7 Special Environment Microorganisms

(a) Person in general charge: Hirotake Horikoshi, Tohoku Institute of Technology professor and senior researcher at RIKEN

(b) Outline

This research involves observing microorganisms raised in special environments, such as alkaline, acidic, and high-temperature environments, and elucidating the resistance mechanisms of these microorganisms; producing useful substances such as new antibiotic organisms by endowing ordinary microorganisms with resistivity; and exploring the possibilities of improving the efficiency of conventional substance production processes.

(c) Research themes: basic properties, substrate regeneration, imparting resistivity

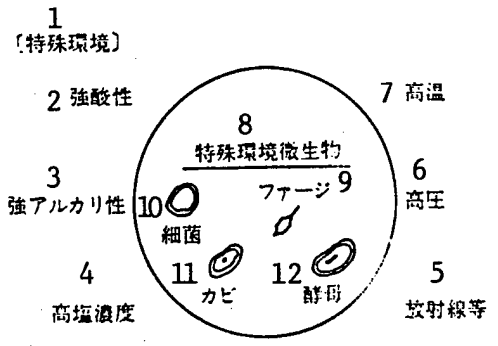
8 Nano Mechanism

(a) Person in general charge: Shoichiro Yoshida, managing director at Nikon Corp.

(b) Outline

This research involves observing and analyzing the substances' physical actions and mechanical properties that occur in the nanometer region, and, through research in new measurement and processing methods, investigating the mechanical and structural elemental technology of the methods.

(c) Research themes: basic analysis, measurement and control, processing




Key:—1. [Special environment]—2. High acidity—3. High alkalinity—4. High salt concentration—5. Radioactivity—6. High pressure—7. High temperature—8. Special Environment Microorganisms—9. Bacteriophage—10. Microbe—11. Mold—12. Yeast

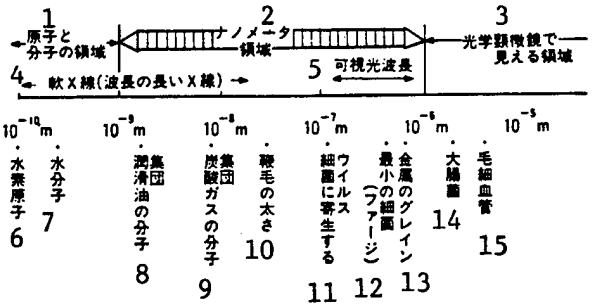
9 Solid Surfaces

(a) Person in general charge: Haruo Kurod, Tokyo University professor

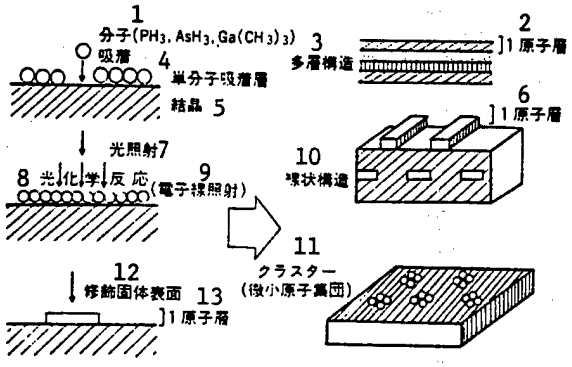
(b) Outline

This work involves searching for methods with which to modify a solid surface of known identity by taking advantage of chemical reactions occurring on the surface; researching the structure, physical properties, and reactivity of modified solid surfaces; and, using the surface modification methods obtained from this research, searching for ways to synthesize new two- and three-dimensionally designed substance groups.

(c) Research themes: basic properties, surface reactions, functional structure




Key:—1. Atomic and molecular region—2. Nanometer region—3. Region visible with an optical microscope—4. Soft x-rays (long wavelength x-rays)—5. Visible light wavelengths—6. Hydrogen atom—7. Water molecule—8. Lubricating oil molecular group—9. Carbon dioxide molecular group—10. Flagellum thickness—11. Parasite on a viral microbe—12. Smallest microbe (bacteriophage)—13. Metallic grain—14. A colon bacillus—15. Capillary




14 固体表面の修飾

15 表面の修飾によって得られる特異な構造を有する物質

Key:—1. Molecule ($PH_3AsH_3Ga(CH_3)_3$) Absorption—2. atomic layer—3. Multilayered structure—4. Monomolecular absorption layer—5. Crystal—6. 1 atomic layer—7. Light irradiation—8. Optical reaction—9. (Electron beam irradiation)—10. Linear structure—11. Cluster (Ultrasmall atomic group)—12. Modified solid surface—13. 1 atomic layer—14. Modification of a solid surface—15. Substance with a unique structure obtained through surface modification

10 Magnetic Flux Quantum Information

(a) Person in general charge: Eichi Goto, Tokyo University professor and and senior researcher at RIKEN

(b) Outline

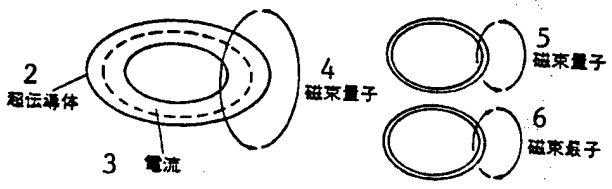
This work involves observing magnetic flux quanta that have characteristics such as the potential for highspeed behavior and low heat generation, and research on the basic organization of devices and circuits, as well as software and architectures, in order to employ magnetic flux quanta as carriers in information processing.

(c) Research themes: basic properties, environmental control, configuration methods

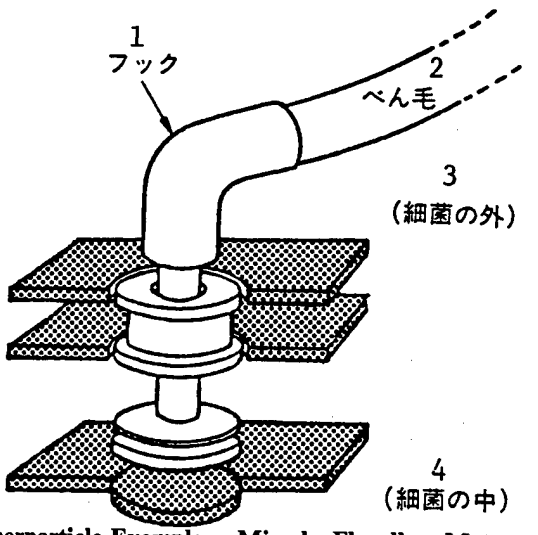
11 Ultraparticle Flexible Structure

(a) Person in general charge: Hiroichi Takaradani, professor at Kyoto University Physics Dept.

1 〔三次元伝送〕




Key:—1. [Three-dimensional transmission]—2. Superconductor—3. Current—4. Magnetic flux quantum—5. Magnetic flux quantum—6. Magnetic flux quantum




**Superparticle Example: a Microbe Flagellum Motor**

Key:—1. Hook—2. Flagellum—3. (Outside of microbe)—4. (Inside microbe)

(b) Outline

This work involves observing the flexible structure of superparticles that adapt to their environments by controlling their own functions, searching for the operational principles behind low-level energy conversion and specific substance transport mechanisms, and searching for clues in the construction of molecular systems that have high-performance functions such as movement and memory.

(c) Research themes: basic analysis, reconfiguration, functional systems

12 Biological Photons

(a) Person in general charge: Fumio Inaba, Tohoku University professor

(b) Outline

This work involves searching for methods with which to precisely measure extremely weak light (bio-photons), a radiation phenomenon that is closely linked with living phenomena, and exploring the possibilities of opening up new measurement technology on the basis of information gained through the use of these methods.

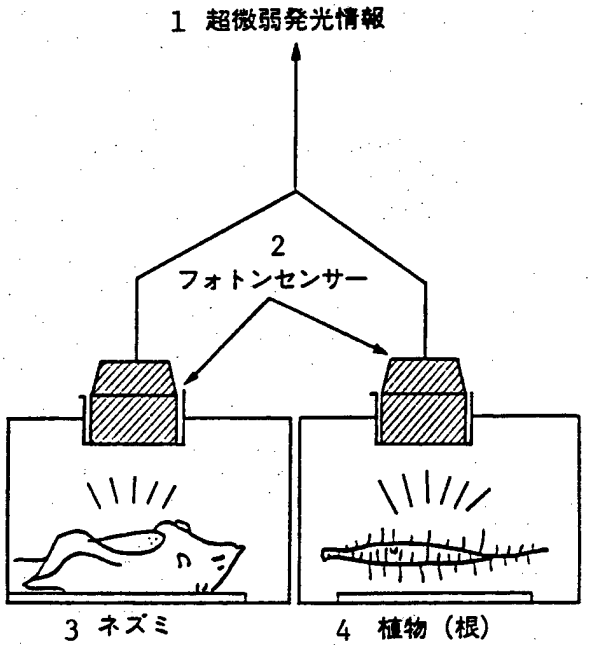
(c) Research themes: measurement technology, biochemical information, information processing

13 Terahertz

(a) Person in general charge: Junichi Nishizawa, Tohoku University professor

(b) Outline

This work involves observing the wavelength region that is unusable for communications purposes, searching for the basic structure of elements that operate in the region from millimeter wavelengths to infrared wavelengths, and exploring possible applications in information engineering.




Key:—1. Ultrasmall, weak radiation information—2. Photon sensor—3. Rat—4. Plant(root)

(c) Research themes: basic analysis, device design, circuit construction

14 Generative Genes

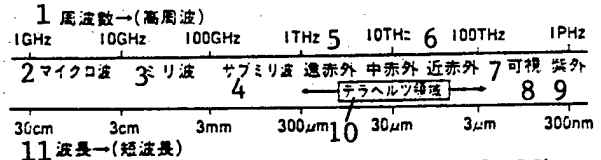
(a) Person in general charge: Mitsuru Furusawa, subchief of the central research facility of Daiichi Seiyaku Corp.

(b) Outline
This work involves observing genes that participate deeply in the developmental process, elucidating the expression and fixation mechanisms of substances synthesized by these genes, and exploring possibilities of applications in medical treatment and agriculture.

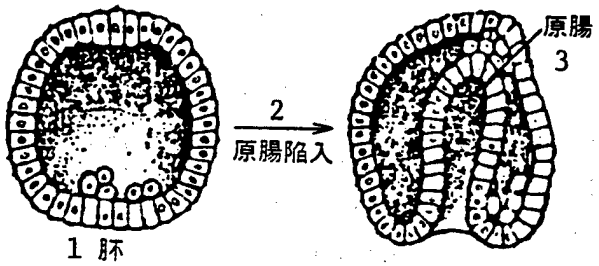
(c) Research themes: genetic investigation, genetic expression, genetic control

15 Chemical Organization

(a) Person in general charge: Toyoki Kokubu, Kyushu University professor




Key:—1. Frequency (high frequency)—2. Micron wave—3. Millimeter wave—4. Sub-millimeter wave—5. Far infrared—6. Mid infrared—7. Near infrared—8. Visible—9. UV—10. Terahertz region—11. Wavelength (short wavelength)




Key:—1. Embryo—2. Subsidence site—3. Site

(b) Outline
This work involves observing the self-organizational characteristics of complex molecules, designing molecules that combine and form arrays with themselves, and exploring the possibilities of uncovering new functional materials.

(c) Research themes: organization design, functional organization, complex organization

16 Quantum Waves

(a) Person in general charge: Yasuhisa Sakaki, Tokyo University professor

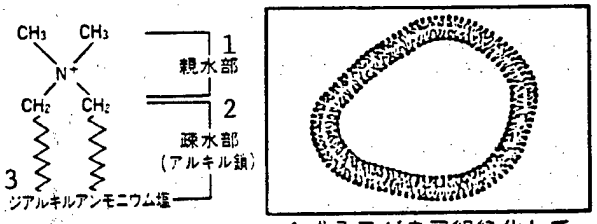
(b) Outline
This work involves observing the characteristics of wave motion exhibited by electrons in superfine structures at the nanometer level, building superfine structures using a variety of electronic materials, and exploring the possibilities of device functionality that takes advantage of the quantum effect.

(c) Research themes:

17 Microscopic Conversions

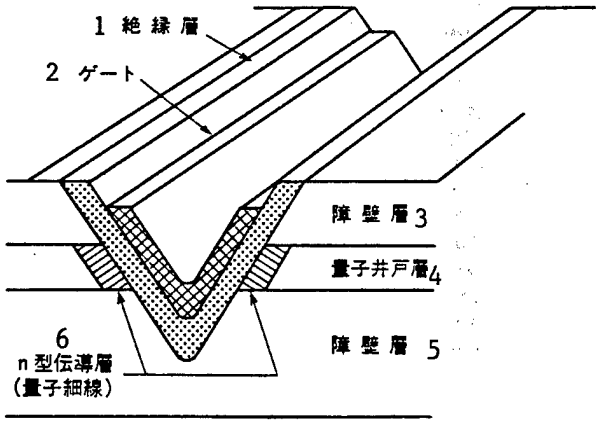
(a) Person in general charge: Hiroshi Masuhara, Kyoto Institute of Technology professor

(b) Outline
This work involves the temporal and spatial analysis of chemical reactions using a pulsed laser, investigating measurement and control methods that approach elucidation of chemical reaction mechanisms, and using these results to explore the possibilities of realizing micron-order optical reaction systems.



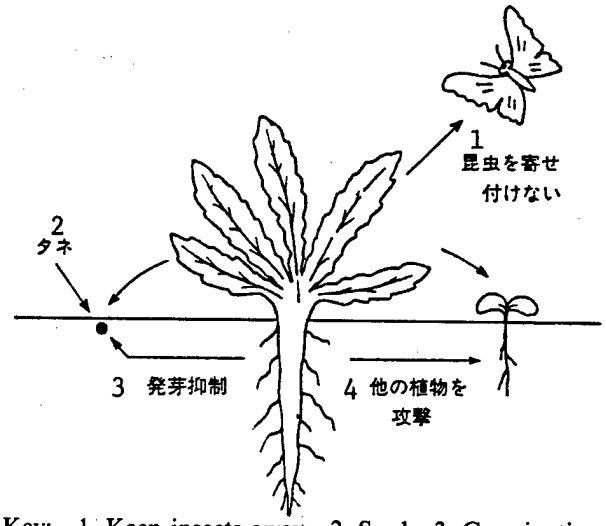

Key:—1. Hydrophilic part—2. Hydrophobic part (alkyl chain)—3. Di-alkyl ammonium salt—4. Complex molecule—5. Bi-molecular film of complex molecules that can undergo self-organization

**Transistor employing quantum fine line structure**




量子細線構造を利用したトランジスタ

Key:—1. Insulating layer—2. Gate—3. Barrier layer—4. Quantum well layer—5. Barrier layer—6. n-type conducting layer




Key:—1. Keep insects away—2. Seed—3. Germination control—4. Attack other plants

(c) Research themes: microscopic measurement, microscopic functions, microscopic control

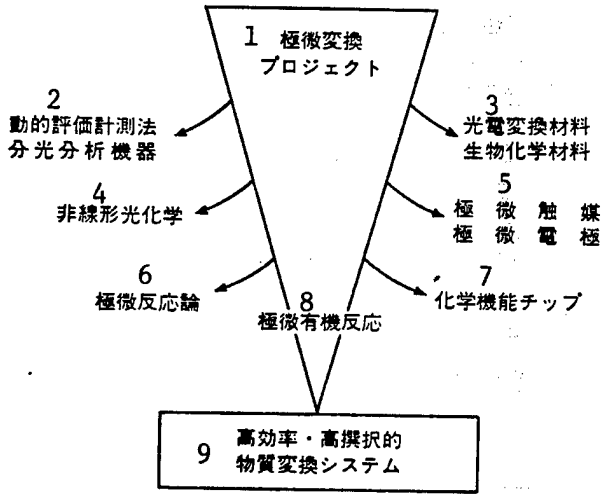
18 Plant Information Substances

(a) Person in general charge: Yoshinari Mizutani, Hokkaido University professor

(b) Outline

This work involves investigating the substances emitted by plants to protect themselves from other plants and insects and to attack animals. By elucidating the acting mechanisms, the possibilities of opening up new avenues for agricultural chemicals will be explored.

(c) Research themes: formation mechanisms, plants vs. plants and microorganisms, plants vs. animals




Key:—1. Microscopic Conversion Project—2. Dynamic evaluation measurement method spectrum analyzer—3. Opto-electric conversion materials, biochemcial materials—4. Nonlinear optics—5. Microscopic catalysts, microscopic poles—6. Microscopic reaction theory—7. Chemically functional chip—8. Microscopic organic reactions—9. Highly efficient and selective substance conversion system

## 3. The State of Research Progress

1) The five-year terms for six research projects that were started in FY 1981, 1982, and 1983 ended.

Since the inauguration of the System for the Promotion of Creative Science and Technology, there have been 1,442 outside publications, and over 511 patent applications have been filed. For most of these research results, nurturing technology has been the objective of the research and experimentation that is being conducted.

At the end of 1988, a conference was held for announcing research results that generated tremendous interest from many different fields.

2) Influenced by the creative research environment of the so-called fluid research system, researchers' enthusiasm for their work is flourishing.

Even private industries, as well, are searching for the seeds of new innovative technology. They are placing a high value on the characteristics of this fluid research system, and requests by private researchers to be sent to other organizations are increasing.

## 4. Leading-edge Research Results Development Enterprise

Since FY 1986, in order to nurture new technology in connection with creative S&T promotion enterprises,

national experimental research institutions, and universities, the Research Development Corp. created the Developmental Experimentation Promotion Group (a high-tech consortium), in which researchers and several businesses from different industrial fields participate. This group conducts developmental experimentation and launched the Leading-edge Research Results Development Enterprise, which establishes the patents from which development towards new technology will originate in the future.

In FY 1988, this group established five themes, including "Organic Nonlinear Optical Materials" and "High-Temperature Superconducting Materials."

(From the Research Exchange Division of the Science and Technology Promotion Bureau)

## Chapter 6. Promoting Research Exchange

### 1. Methods for Encouraging Research Exchange

Research and development in recent years has been getting more sophisticated and more complex and is expanding into frontier areas and interdisciplinary areas. From now on, to promote further creative research for advanced technology, it is essential that we actively promote the actualization of a structure that will enable both human and material exchange in research—exchange between different fields and exchange that goes beyond the bounds of research organizations. Striving for the efficient and effective utilization of limited research resources is also very important.

From this kind of standpoint, the following guidelines for encouraging research exchange were adopted in the "Report on Promotional Policies for Administrative Reform," dated July 1985, from the Provisional Council for the Promotion of Administrative Reform: 1) to encourage joint R&D that overcomes the bounds of research organizations in industry, universities, and the government; 2) to expand opportunities for mutual exchange of advisory publications and information among researchers from different fields and organizations; 3) to realize internationally open research organizations; 4) to open institutions, facilities, and information to the public and to encourage their shared use. The report also indicated the needs for the country to promote the activation of research activities in its research organizations and to service and improve the various systems required in carrying out the smooth establishment of research exchange.

In encouraging research in such a context, though, legal bottlenecks were encountered. In order to improve upon these legal bottlenecks, the Cabinet decision entitled "Basic Policy on the Operation of Systems Connected with the Promotion of Research Exchange among Industry, Universities, the Government and Foreign Countries" was implemented in March 1987, and preparations in the legal system for dealing with the increased social needs of research exchange were carried out.

In FY 1988, we continued our efforts from the previous fiscal year to promote research exchange among industry, universities, and the government through the application of the Research Exchange Law.

(From the Research and Development Promotion Division of the Science and Technology Promotion Bureau)

**Table 1-6-1. Contents of the Research Exchange Promotion Law**

| Item | Legal system prior to the implementation of the Research Exchange Promotion Law | Special measures of the Research Exchange Promotion Law |
|---|---|---|
| (1) Employing foreigners | In accordance with the nature of legal principles, only ordinary researchers engaged in experimental research may be employed. | Research department heads and research office heads can be hired (Article 3). |
| (2) Participating in research conferences | Official business (business trip or foreign duty) or vacation | In addition, as a third means, the law opens the way for participation by being excused from work obligations (Article 4). |
| (3) Improving disadvantages of retirement allowances when leaving for the private sector | When leaving work to engage in research at a school, research institute, hospital or other public facility (research leave), retirement allowance for the leave period is halved. | The full retirement allowance is provided in the case of leaves for engaging in national joint research or national consignment research (Article 5). |
| (4) Improving the treatment of patent rights for nationally consigned research | The government acquires the patent rights. | The government can transfer a portion of the patent rights to the consignee who bore the investment (Article 6). |
| (5) Using grants or fee reductions for patents related to international joint research | There are many instances of demands for use of no-fee or reduced-fee national patent rights when conducting international joint research. Although a legal basis for this is needed, there are no fundamental laws, only laws for special cases. | The law opens the way for joint research with a foreign government, public groups of foreign countries, or international organizations (Article 7). |

**Table 1-6-1. Contents of the Research Exchange Promotion Law (Continued)**

| | | |
|---|---|---|
| (6) Abandoning the right to request damage compensation in connection with international joint research | There are many instances of demands for abandoning the right to request damage compensation in connection with international joint research. Although a legal basis for this is needed, there are no fundamental laws, and the right cannot be abandoned. | Same as above (Article 8). |
| (7) Using reduced fees for experimental research facilities | A legal basis for permission to use government properties at reduced fees is needed, but the only legal bases are for special cases. | The law opens the way for researchers closely connected to the research of the government organization managing the research facility and for those who conduct particularly beneficial research in the area concerned, to provide the results of their research (Article 9). |
| (8)Items worth attention | | When conducting international research according to the special measures of this law, special attention shall be paid to observing the obligations set forth in the contract or international agreement and to maintain international peace and safety (Article 10). |

**Table 1-6-2. Contents of Basic Policy on the Operation of Systems Connected with the Promotion of Research Exchange among Industry, Universities, the Government and Foreign Countries (a Cabinet decision dated 31 March 1987)**

| Item | Contents |
|---|---|
| 1 Encouraging joint research | When carrying out joint research, official regulations are furnished so that private researchers can engage in research activities at a national experimental research institution.<br>Official regulations are furnished to enforce prioritized approval for state-owned patent rights obtained as results of joint research. |
| 2 Encouraging exchange among researchers | A system is furnished for accepting private researchers in national experimental research institutions.<br>Authorization procedures for government researchers to do sideline research work are simplified.<br>Short-term employment of government researchers will be studied.<br>Exchange among researchers will be encouraged in accordance with implementation of employment systems of the country's research institutions. |
| 3 Special cases of planning out work hours for government researchers | Official regulations are furnished in connection with special cases of planning out work hours for government researchers. |
| 4 Encouraging research exchange with foreign countries | To increase the opportunities for foreign researchers who work on national research to be easily granted academic degrees, research exchange between national universities and national research [institutes] will be promoted, and effective use will be made of the doctorate thesis system. |
| 5 Opening the facilities, equipment, and information of the country's research organizations to the public | To encourage the opening of the facilities, equipment, and information of the country's research organizations to the public, information will be provided about research facilities and equipment.<br>Providing information about the research in the country's research organizations and disseminating research results will be encouraged. |
| 6 Establishing the Research Exchange Promotion Liaison Council Assembly | In connection with research exchange, close contact among all of the ministries and agencies will be worked towards, and the Research Exchange Promotion Liaison Council Assembly will be established to assist in the smooth promotion of research exchange. |

### 2. Special Joint Research between the Government and the People

As indicated in the Council for Science and Technology's Report No 11, "The Basic and Comprehensive Policy for the Promotion of Science and Technology from a Long-Term Perspective and for Coping with Changes in the Situation," and in the "Report on Promotional Policies for Administrative Reform" from the Provisional Council for the Promotion of Administrative Reform, joint research that overcomes the bounds of research organizations will be conducted, and the necessity of moving forward with effective and efficient R&D is increasing. For these reasons, the Science and Technology Agency made the most it could of the human and financial potential of private organizations involved in the agency's experimental research during FY 1986. These efforts were combined with R&D conducted through the "System for Special Joint Research between the Government and the People," which the Science and Technology Agency created.

The features of this system are: 1) the acceptance of researchers from private organizations in the Science

and Technology Agency's research institutes; 2) the joint use of the agency's research institutes' facilities and equipment, and approving equipment brought in from even private organizations that is required for research; and 3) because the government and a private organization jointly own the patent rights resulting from joint research, the system made it possible for the government and the people, acting as one body, to implement R&D.

(From the Policy Division of the Research and Development Bureau)

### 3. Research Exchange in Tsukuba Science City

Tsukuba Science City answers the demands of the times with respect to our country's scientific and academic research; it is expected to become the strategic point for carrying out education and high-level research. Roughly built at the end of FY 1979, there are now 47 national experimental research institutions established there.

The Science and Technology Agency is working towards a well-rounded research structure in the affiliated organizations which were moved to or newly built in Tsukuba Science City. The agency is setting up sophisticated research facilities, equipment, and services for an ideal research environment there, so that research activities can be carried out smoothly, and indeed, so that the accumulated effect of these activities can be made manifest. The agency is also setting up facilities and equipment there for joint use and, in connection with the treatment of research workers, is overseeing the general coordination of administrative organizations.

#### (1) Research Exchange Center

To encourage research exchange, the Research Exchange Center is 1) promoting cooperative research activities such as research and information exchange meetings for each specialized field; 2) holding research seminars, symposia, classes, and training programs; 3) publishing "Science Communication" and providing information about Tsukuba Science City's research activities in comparison with domestic and foreign research; 4) issuing a variety of publications for the purpose of research exchange; 6) building and managing the Tsukuba Network; and 7) overseeing the management of lodging for foreign researchers.

#### (2) Tsukuba Science City Research Organizations Coordinating Council

The Tsukuba Science City Research Organizations Coordinating Council consists of the heads of the organizations in Tsukuba Science City. Its activities are carried out with the goals of smoothly executing research operations in universities and organizations and encouraging cooperation in research where all the organizations maintain mutually coordinated cooperation. The Science and Technology Agency's Research Exchange Center is becoming the administrative bureau for this council.

(From the Research and Development Cooperation Division of the Science and Technology Promotion Bureau)

## Chapter 7. Regional S&T Promotion

### 1. About Regional S&T Promotion

Lately, the sophistication of R&D functions is accelerating, the promotion of local areas is gaining speed, and even in CST Report No 11 (a Cabinet decision in November 1984) and the fourth Comprehensive National Development Plan (a Cabinet decision in June 1987), the strengthening of local R&D functions is considered to be a strategic topic in the activation of regional areas.

More efficient and effective R&D activity must be stepped up for the enthusiastic local industrial, university, and governmental research institutions, which added to S&T promotion through mid-level R&D organizations.

Basing its reasoning on this, the Science and Technology Agency has been actively pushing regional S&T promotion, with efforts such as the Local Research Exchange Promotion Project, which it started in FY 1988. The agency has also taken part in planning surveys aimed at advancing R&D functions so that a specific region is observed and then the greatest possible use is continually made of that region's R&D potential. In addition to implementing the "Survey on Plans for Advancing Scientific, Technical, and Information Functions in the Northeast," which focuses on the Tohoku region, the agency also participated in planning the "Survey on the Actualization of the Cultural, Academic, and Research Exchange Facilities," which has to do with the Kansai Culture, Academy, and Research City, and the "Survey on the Greater Nagoya Area Academic and Research City," which focuses on the Nagoya region. (From the Research and Development Cooperation Division of the Science and Technology Promotion Bureau)

### 2. Regional Research Exchange Promotion Enterprises

The Regional Research Exchange Promotion Enterprises were begun in FY 1988 to advance the standards of regional R&D by continuing to make the most of regions' R&D potentials, under the coordinated cooperation with national and other such R&D functions, and by encouraging research exchange across and beyond the regions.

The idea of these enterprises is to maintain regional research information networks, and with the networks as the nucleuses, to encourage human and information exchange within regions, and between regions and Tsukuba Science City, and to promote the commercialization of research results in regions which took advantage of various systems of the Research Development Corp. In concrete terms, model regions were selected to effectively promote the enterprises, and model enterprises are being put into operation.

Shizuoka Prefecture, the Toyama Prefecture and Ishikawa Prefecture region, and Oita Prefecture were selected as model regions. In these model regions, local research information networks were constructed and connected with the Tsukuba network that is being built in Tsukuba Science City, and various systems of the Research Development Corp. were utilized. Also, trainees from these model regions were accepted in national research institutes, and instructors from national research institutes were dispatched to these regions.

Additionally, the Conference for the Promotion of Local Science and Technology, specific joint research between the government and private groups, and local joint R&D projects were implemented. (From the Research and Development Cooperation Division of the Science and Technology Promotion Bureau)

### 3. Local Science and Technology Promotion Conferences

Since FY 1963, the Science and Technology Agency has been pushing the Promotion of Local Science and Technology Conferences.

These conferences, which are held in each of the country's regional blocs (eight blocs), are an opportunity for people, starting with those involved with S&T and including others from various related circles, to gather together. The objectives of the conferences are for the nation and regions to come to a mutual understanding of each others' intentions, to investigate all of the problems connected with the promotion of S&T in the regions, to pave the way for cooperation among all of the S&T-related organizations and each of the various fields, and to lay the groundwork for S&T promotion in the regions.

In FY 1988, the state of this implementation was as follows.

**1. Ninth Tohoku Science and Technology Promotion Conference**

| | |
|---|---|
| Day and Time | 6 June 1988 (Monday) 13:00 to 16:00 |
| Place | Eyo Grand Hotel (Sendai City) |
| Sponsored by | Science and Technology Agency, Miyazaki Prefecture, Tohoku Science and Technology Promotion Council |
| Theme | "Science and Technology that Hopes for Happiness and Opens up the Future of Mankind" |
| Attendance | 900 people |

**2. Seventh Hokuriku Region Science and Technology Promotion Conference**

| | |
|---|---|
| Day and Time | 18 October 1988 (Tuesday) 10:00 to 15:00 |
| Place | Kanazawa City Cultural Hall (Kanazawa City) |
| Sponsored by | Science and Technology Agency, Ishikawa Prefecture |
| Theme | "Topics in 21st-Century-Oriented Science and Technology Promotion in Ishikawa Prefecture" |
| Attendance | 200 people |

(From the Policy Division of the Science and Technology Promotion Bureau)

## Chapter 8. S&T Information Activities Promotion

### 1. NIST Promotion

In connection with our country's S&T information distribution, the 1969 Council for Science and Technology hammered out the concept of the "National Distribution System for Scientific and Technological Information," indicating the basic direction for S&T information activities. In order to realize this concept, the Science and Technology Agency is striving to nurture and strengthen the multi-purpose Japan Information Center of Science and Technology and specialized information organizations.

As a part of this, the "Knowledge-Based Chemical Substance Design System Research" program was continued into FY 1988 from the previous year with support from the Coordination Funds for Promoting Science and Technology.

To assist in the construction of a knowledge-based system for supporting various kinds of R&D, such as the design of new chemical substances, this research entails the development of technology with which to build a knowledge-based system, a structural design knowledge-based system for the design of structural candidates, and a knowledge-based system for the design of reactions in connection with candidate structure substances.

Additionally, the Science and Technology Agency organizes the board of governors meetings for liaison committees of ministries and agencies concerned with the NIST (where 16 government ministries and agencies, including the National Diet Library and the Science Council of Japan, exchange opinions and put together budgets) and the NIST Information Service Organization Liaison Conference (where 21 organizations, such as the Japan Science and Technology Information Center and the Japan Patent Information Organization, exchange opinions).

The FY 1988 budget for our country's S&T information distribution is given in Table 1-8-1.

**Table 1-8-1. Budgets for Science and Technology Information Distribution (Unit: ¥ 1 million)**

| Ministry or Agency Name | Breakdown | FY 1988 budget | FY 1987 budget |
|---|---|---|---|
| National Diet Library | | 1,122 | 1,105 |
| Science Council of Japan | | 2 | 2 |
| Science and Technology Agency | General promotion of NIST | 344 | 344 |
| | Japan Science and Technology Information Center | 6,812 | 6,401 |
| | Japan Atomic Energy Research Institute | 376 | 371 |
| | Power Reactor and Nuclear Fuels Development Corp. | 226 | 221 |
| | Miscellaneous | 1,640 | 1,553 |
| Environment Agency | National Pollution Research Institute | 381 | 384 |
| | National Minamata (mercury poisoning) Research Center | 2 | 3 |
| Ministry of Education, Science and Culture | Science Information Center[1] | 1,786 | 1,564 |
| | Science Information Center maintenance | 10,994 | 10,358 |
| | Preparation and maintenance of secondary information | 371 | 233 |
| | Publication of primary information | 980 | 980 |
| | Maintenance and provision of special materials and data | 625 | 617 |
| | Information processing R&D | 419 | 419 |
| Ministry of Health and Welfare | Pharmaceuticals safety investigation | 51 | 48 |
| | Medical information processing system development and dissemination | 223 | 221 |
| | National Health Laboratory | 20 | 13 |
| Ministry of Agriculture, Forestry and Fisheries | Agriculture, Forestry and Fisheries Research Council Administrative Bureau | 432 | 422 |
| MITI | Agency of Industrial Science and Technology | 11 | 11 |
| | Small and Medium Enterprise Agency | 879 | 718 |
| | Patent Office[2] | 4,753 | 3,744 |
| Ministry of Transport | Marine Data Center operations | 159 | 133 |
| Ministry of Posts and Telecommunications | Radio Research Laboratory | 23 | 23 |
| Ministry of Labor | Hazardous materials investigative measures | 12 | 12 |
| Ministry of Construction | Construction Research Institute | 2 | 2 |
| Total | | 32,635 | 29,902 |

Notes: 1. In addition, library purchases for public schools and research institutes amounted to ¥ 1.808 billion (¥ 1.750 billion), of which most is for science and technology.

2. In addition, publication costs for patent announcements amounted to ¥ 9.019 billion (¥ 7,934 billion).

## 2. S&T Information Activity Promotion Undertakings

The Science and Technology Agency is carrying out the following as basic undertakings for the promotion of S&T information activities.

1) Promoting the standardization of S&T information distribution technology conventions
2) Promoting fact database activities
3) Investigating trends in domestic S&T information activities
4) Drafting a comprehensive review magazine

To facilitate the distribution of S&T information, standardization promotion furthers the drafting of standards on the contents of bibliographical descriptions and other entries and the machine readability formulas for those conventions.

The standards and proposals for standards that have been drafted up until now are shown in Table 1-8-2. Also, there is an SIST handbook for disseminating these standards.

**Table 1-8-2. Standards and Standards Proposals**

| No. | Name of Standard | Year |
|---|---|---|
| SIST 01 | Drafting Excerpts | 1980 |
| SIST 02 | Reference Literature Writing Styles | 1984 |
| SIST 03 | Record Formats for Bibliographical Information Exchange (External formats) | 1980 |
| SIST 04 | Record Formats for Bibliographical Information Exchange (Internal formats) | 1983 |
| SIST 05 | Magazine Name Abbreviations | 1981 |
| SIST 06 | Organization Name Notations | 1981 |
| SIST 07 | Academic Magazine Composition and Its Components | 1985 |
| SIST 08 | Academic Thesis Composition and Its Components | 1986 |
| SIST 09 | Scientific and Technological Report Conventions | 1987 |
| SIST 10 | Bibliographic Data Descriptions | 1985 |
| SIST 11 | Numerical Information Exchange Record Composition (proposal) | 1987 |
| SIST 12 | Conference Preliminary Draft Collection Conventions (proposal) | 1988 |
| SIST 13 | Index Drafting (proposal) | 1989 |

(Note) SIST=Standards for Information of Science and Technology

(From the Information Division of the Science and Technology Promotion Bureau)

Fact database activities are promoted as a part of numerical data activities in NIST.

In building a fact database, the importance of which has been suddenly increasing in recent years, this investigation involves examining systems and methods for finding, evaluating, preparing, and distributing data. Additionally, an objective of the investigation is, by studying the needs of users, to be of use in promoting future fact database activities.

In FY 1988, the Science, Technology, and Economy Association Inc. was commissioned to conduct investigative research on what the basic materials should be for expediting fact database distribution, S&T information databases which included the in-house databases of all companies, the current state of affairs in the industrial sector, and future trends.

Regarding investigations of trends in domestic S&T information activities, Mitsubishi Research Institute Inc. was commissioned to carry out "Investigative Research on the International Distribution of Scientific and Technological Information," with funding from the Coordination Funds for Promoting Science and Technology.

Also, in general review activities, "Leading-Edge Database Technology" was published as the last volume of a series on the current state of and outlook on leading-edge S&T in FY 1988.

### 3. International Cooperation

Even international exchange in S&T information activities is at the stage where we are promoting it the same as we are promoting domestic distribution system operations. International cooperation is progressing with participation in the planning of S&T information activities of international organizations and mutual cooperation in S&T information activities with specific countries. Examples of the former include participating in meetings of the OECD's CICCP (Committee on Information, Computers, and Communication Policies), operations of UNESCO's GIP (General Information Program), and activities of the ASCA (Asian Scientific Cooperation Association). Examples of the latter include cooperative activities between Japan and the US, Japan and Germany, and Japan and France.

(From the Information Division of the Science and Technology Promotion Bureau)

## Chapter 9. Maintaining Systems for Gathering, Storing and Supplying Genetic Resources

Because biological materials of guaranteed quality are needed in life sciences research, maintaining systems through which genetic resources can be collected, preserved, and supplied is important.

### 1. Cellular and Genetic Storage Enterprise (Gene Bank Enterprise)

The Institute for Physical and Chemical Research (RIKEN) has partially begun a cellular and genetic storage enterprise (the Gene Bank Enterprise). This enterprise involves gathering, preserving, and supplying the common and basic cellular and genetic materials and genetic information that are necessary in the advancement of life science research.

The contents of the Gene Bank Enterprise are as follows. Items within parentheses are planned.

1. Gathering and preserving cellular and genetic materials (supplying)
2. Inspection and verification to ensure the quality of materials
3. Collecting, storing, and supplying information about cellular and genetic materials, and collecting and developing software for analyzing genetic information

4. New material development and R&D work on methods of preserving and handling the materials
5. (Comprehensively promoting the Gene Bank Enterprise by cooperation with related foreign and domestic organizations)

Continuing from FY 1987, the gathering and preserving of animal cell materials and genetic materials is being carried out in FY 1988.

### 2. Microorganism Preservation Enterprise

As a system for gathering, preserving, and supplying genetic resources at the individual level, RIKEN has been carrying out operations of the Microorganism Strains Preservation Enterprise. Since FY 1983, this enterprise has been making progress in the collection, storage, and supply of microorganisms that are useful in industry and research, together with taxological research and the development of storage technology, but only since FY 1987 has it begun to actually supply preserved microorganisms.

[Chapter 10 omitted]

## Chapter 11. Development and Utilization of Atomic Energy

### 1. Atomic Energy-Related Budgets

Our country's atomic energy-related budgets are shown in Tables 1-11-1, 1-11-2, and 1-11-3.

**Table 1-11-1. FY 1988 Atomic Energy-Related Budget**
**(*Amount of National Treasury debt liability limit) (Unit: ¥1 million)**
**(Items in () show FY 1987 budget amounts)**

| Item Ministry or Agency | Science and Technology Agency | MITI | Ministry of Foreign Affairs | Total |
|---|---|---|---|---|
| General accounts | *33,894 (*36,299) | | | *33,894 (*36,299) |
| | 176,407 (*178,811) | 251 (254) | 4,466 (4,243) | 181,124 (183,308) |
| | (98.7%) | (98.8%) | (105.3%) | (98.8%) |
| Special accounts for promoting development of electric power resources | *79,410 (*82,060) | | | *79,410 (*82,060) |
| | 95,083 (94,552) | 91,014 (82,363) | | 186,098 (176,914) |
| | (100.6%) | (110.5%) | | (105.2%) |
| Electric power resource siting account | 15,032 (12,596) | 64,463 (55,518) | | 79,495 (68,114) |
| | (119.3%) | (116.1%) | | (116.7%) |
| Electric power resource diversification account | *79,410 (*82,060) | | | *79,410 (*82,060) |
| | 80,051 (81,956) | 26,551 (26,845) | | 106,603 (108,800) |
| | (97.7%) | (98.9%) | | (98.0%) |
| Total | *113,303 (*118,359) | | | *113,303 (*118,359) |
| | 271,491 (273,363) | 91,265 (82,617) | 4,466 (4,243) | *113,303 (*118,359) |
| | (99.3%) | (110.5%) | (105.3%) | (101.9%) |

**Table 1-11-2. Science and Technology Agency-Related General Accounts and Special Accounts for Electric Power Development Promotion Measures**
**(Unit: ¥1 million, *Amount of National Treasury debt liability limit)**

| | | | |
|---|---|---|---|
| Promoting atomic energy R&D and utilization | *118,359 | *113,303 | Comparison with previous year 99.3% |
| | 273,363 | 271,491 | |
| General accounts | *36,299 | *33,894 | " 99.1% |
| | 178,811 | 176,407 | |
| Special accounts for promoting development of electric power resources | *82,060 | *79,410 | " 112.3% |
| | 94,552 | 95,083 | |
| Electric power resource siting account | 12,596 | 15,032 | " 102.2% |
| Electric power resource diversification account | *82,060 | 79,410 | " 101.2% |
| | 81,956 | 80,051 | |

**Table 1-11-2. Science and Technology Agency-Related General Accounts and Special Accounts for Electric Power Development Promotion Measures**
**(Unit: ¥1 million, *Amount of National Treasury debt liability limit) (Continued)**

| | | | |
|---|---|---|---|
| 1. Strengthening and rounding out atomic energy safety measures | *6,237 | *8,808 | Rounding out atomic energy safety regulation administration, promoting safety research, strengthening disaster prevention measures, rounding out environmental radioactivity observation systems, etc. |
| | 26,876 | 29,020 | |
| (1) Rounding out atomic energy safety regulation administration | 1,078 | 1,112 | Rounding out the functions of the Nuclear Safety Commission and the regulatory operations based on laws such as the Nuclear Reactor Regulation Law. |
| (2) More promotion of safety research | *6,237 | *8,808 | Engineering-type safety research, environmental radioactivity safety research, promoting radioactive waste safety research. |
| | 21,194 | 21,963 | |
| (3) Strengthening disaster prevention measures | 1,329 | 1,543 | Rounding out disaster prevention measures such as preparing a communications net for emergency situations. |
| (4) Strengthening radiation sickness prevention measures | 2,211 | 2,139 | Rounding out safety regulations for radioactive isotopes, strengthening radiation sickness prevention measures with regard to people working in atomic energy facilities. |
| (5) Ensuring environmental safety | 3,448 | 4,648 | Intensifying environmental radioactivity inspections, etc. |
| 2. Promoting atomic power generation | 2,280 | 2,106 | Promoting R&D efforts in technology for dismantling nuclear reactors, technology for minimizing workers' exposure to radiation, etc. |
| 3. Establishing the nuclear fuel cycle | 16,393 | *29,777 | To establish the nuclear fuel cycle, investigative prospecting for overseas uranium resources, construction of a uranium-enrichment plant that uses the centrifugal separation method, operations of spent fuel reprocessing facilities, and promoting radioactive waste processing and disposal measures. |
| | *56,437 | 50,375 | |
| (1) Promoting security of uranium resources | 5,597 | 3,647 | Promoting expansion of investigative prospecting activities for overseas uranium resources |
| (2) Promoting uranium-enrichment technology development | *1,757 | *1,004 | Operations of a uranium-enrichment plant, construction of a prototype plant, development of uranium-enrichment technology based on laser methods. |
| | 14,144 | 7,417 | |
| (3) Promoting reprocessing measures | *13,151 | *7,192 | Operations of the PNC's reprocessing facilities. Related technology R&D and facilitating the planning of private-sector reprocessing plants. |
| | 14,909 | 20,331 | |
| (4) Promoting radioactive waste processing and disposal measures | *7,462 | *21,581 | Promoting R&D for low-level and high-level radioactive waste processing and disposal technology, etc. |
| | 24,337 | 19,160 | |
| 4. Advanced power reactor development and plutonium utilization | *76,802 | *65,335 | In working towards the effective utilization of nuclear fuels, promoting the development of advanced power reactors which can bring about the most highly effective nuclear power generation. |
| | 80,090 | 83,584 | |
| (1) Fast breeder reactor development | *75,053 | *63,234 | Construction of the "Monju" prototype reactor, irradiation experiments on materials and FBR fuels. |
| | 55,825 | 65,294 | |
| (2) Advanced thermal converter reactor development | *60 | | Operating the "Fugen" prototype reactor, promoting demonstration reactor plans, related research, etc. |
| | 2,587 | 1,504 | |
| (3) Miscelleneous | *1,690 | | Constructing facilities for the development of fuel production technology for FBRs and advanced thermal converter reactors. |
| | 21,678 | 16,786 | |

**Table 1-11-2. Science and Technology Agency-Related General Accounts and Special Accounts for Electric Power Development Promotion Measures (Unit: ¥1 million, *Amount of National Treasury debt liability limit) (Continued)**

| | | | |
|---|---|---|---|
| 5. Promoting pioneering projects | *974 | *16,279 | Promoting experimental research in high-temperature engineering aimed at fusion, which is expected to be mankind's ultimate energy source, and utilization of thermonuclear energy in fields other than power generation. |
| | 33,748 | 46,372 | |
| (1) Fusion R&D | *974 | *3960 | Experimental research using the JT-60 critical plasma test device; superconducting magnets; tritium and other related technology R&D. |
| | 29,711 | 23,756 | |
| (2) Promoting experimental research in high-temperature engineering | *162 | *311 | Operating large demonstration-experiment loop apparatuses, pre-construction preparations for a high-temperature engineering experimental research reactor. |
| | 4,037 | 4,222 | |
| (3) Promoting nuclear-powered ship R&D | 9,245 | 7,313 | Promoting the construction of a new port of registry for the nuclear-powered ship, "Mutsu," etc. |
| (4) Promoting radiation utilization | *10,916 | *12,008 | Advancement in radiation utilization technology. |
| | 7,426 | 11,075 | |
| 6. Intensifying safeguards and measures for safeguarding nuclear materials | 2,499 | 2,932 | Promoting the rounding out and strengthening of safeguards based on the Nuclear Weapon Non-Proliferation Treaty and investigative research in connection with the domestic safeguarding of nuclear materials. |
| 7. Strengthening policies to gain the understanding and cooperation of the nation's citizens | 12,751 | 15,318 | Promoting harmonization in locating sites for nuclear power facilities, such as expanding measures, based on the three electric power source methods, that are necessary for improving the well-being of people living near nuclear power facilities. |

**Table 1-11-3. Nuclear Power Related Administrative Costs for Each Ministry in FY 1988 (Excluding Science and Technology Agency) (Unit: ¥1000)**

| Ministry | Item | FY 1987 Budget | FY 1988 Budget | Increase or Decrease |
|---|---|---|---|---|
| Ministry of Foreign Affairs | | 2,743,993 | 2,881,606 | 137,673 |
| | 1. IAEA allotment and donations | 2,531,064 | 2,654,684 | 123,620 |
| | 2. OECD-NEA allotment | 196,618 | 210,671 | 14,053 |
| | 3. International conference participation | 16,251 | 16,251 | 0 |
| Ministry of Transport | | 32,343 | 33,626 | 1,283 |
| | 1. Investigative analyses needed to determine safety standard measures for transporting radioactive materials | 22,375 | 23,353 | 978 |
| | 2. Safety confirmations for transporting radioactive materials, etc. | 3,300 | 3,605 | 305 |
| | 3. Guidance in radioactive material transport safety by holding classes, etc. | 2,957 | 2,957 | 0 |
| | 4. Safety measures for nuclear-powered ships | 192 | 192 | 0 |
| Ministry of Agriculture, Forestry and Fisheries | | 318,629 | 362,037 | 43,408 |
| | 1. Fees needed for melon fly extermination enterprises in the Enmi Archipelago | 318,629 | 362,037 | 43,408 |
| Okinawa Development Agency | | 1,145,255 | 1,186,594 | 41,339 |
| | 1. Fees needed for melon fly extermination enterprises in Kumejima and other islands near Okinawa | 1,145,255 | 1,186,594 | 41,339 |
| Ministry of Health and Welfare | | 579 | 579 | 0 |

**Table 1-11-3. Nuclear Power Related Administrative Costs for Each Ministry in FY 1988 (Excluding Science and Technology Agency) (Unit: ¥1000) (Continued)**

| Ministry | Item | FY 1987 Budget | FY 1988 Budget | Increase or Decrease |
|---|---|---|---|---|
| | 1. Supervisory expenses for medical apparatuses, etc. | 297 | 297 | 0 |
| | 2. Costs of guidance for control and surveillance of medical supplies | 282 | 282 | 0 |
| Ministry of Home Affairs | | 1,766 | 1,766 | 0 |
| | 1. Costs required for guidance in nuclear disaster measures | 1,766 | 1,766 | 0 |
| MITI | | 253,684 | 250,730 | -2,954 |
| | 1. Supervision of nuclear power generation safety investigations | 175,033 | 175,171 | 138 |
| | 2. Administering nuclear power generation | 3,871 | 3,863 | -8 |
| | 3. Surveys of trends in the nuclear power industry | 6,754 | 6,079 | -675 |
| | 4. Measures for promoting the establishment of nuclear fuel enterprises | 38,215 | 38,056 | -159 |
| | 5. Radioactive waste processing and disposal measures | 26,503 | 23,971 | -2,532 |
| | 6. General administrative expenses | 3,308 | 3,590 | 282 |
| | Total | 4,496,189 | 4,716,938 | 220,749 |

(From the Policy Division of the Atomic Energy Bureau)

## 2. Promoting Nuclear Power Generation

### (1) Promoting Nuclear Power Generated Electricity

With the Chugoku Electric Power Co. Shimane Nuclear Power Plant No 2 starting new operations in February 1990, our country's 36 operational commercial nuclear power plants currently, at the end of FY 1988, amount to 28.701 billion watts, accounting for approximately 17.4% of the total power generating plant capacity and 27% (estimated results) of the total generated power volume. In addition, there are 13 plants under construction which will output 12.845 billion watts, and construction of four plants that will output 4.362 billion watts is in the course of preparation.

Currently, the global petroleum supply-and-demand situation is temporarily easing, but, because it is expected to get tighter in the mid- to long-term, it is necessary to overhaul our country's energy supply structure, which depends a great deal on petroleum. Nuclear power generation possesses many excellent characteristics, such as affordability and supply stability, and it ranks as an energy means which helps to overcome the fragility of our country's energy supply structure. We must continue to promote its development and concentrate on improving its safety, reliability, and cost characteristics.

(From the Policy Division Research Office of the Atomic Energy Bureau)

**(2) Three Power Source Methods In recent years, the funds needed for nuclear power R&D have been suddenly and dramatically increasing, in step with the progress of large projects such as FBRs and nuclear fusion. Seeking all of those funds from general sources of revenue is difficult in today's tough financial circumstances.**

For these reasons, the Power Resource Development Promotion Tax Law was revised in October 1983, the tax rate was raised (from ¥0.300/kWH to ¥0.445/kWH), and ways were devised to guarantee the funds needed for electrical resource siting and diversification measures.

For nuclear energy in FY 1988, ¥15.0 billion was appropriated for the electrical resource siting account and ¥81.1 billion for the electrical resource diversification account, as the operating funds needed to promote the development of advanced power reactors, spent-fuel reprocessing technology, uranium-enrichment technology, etc. (the portion related to the Science and Technology Agency).

Since FY 1988, ¥34 million for commissioned studies on the operations and management of nuclear fuel cycle facilities plan was added to the electrical resource siting account, ¥21 million for commissioned maintenance of the radioactive waste disposal safety analysis code was added to the electrical resource diversification account; funding continued for commissioned development of nuclear reactor dismantling technology, ¥1.865 billion, and for commissioned test research on safeguards for environmental safety in connection with reprocessing, ¥641 million.

(From the Siting Region Measures Office of the Policy Division of the Atomic Energy Bureau)

**Table 1-11-4. Current State of Our Country's Nuclear Power Facilities (March 1989)**

| Founder | Name of Power Plant | Location | Type of Reactor | Electrical Output (1000 kW) | Start of Operations |
|---|---|---|---|---|---|
| **Operational** | | | | | |
| Japan Atomic Power Co. | Tokai | Ibaraki Prefecture, Naka District, Tokai Village | GCR | 166 | 25 July 1966 |
| " | Tokai No 2 | " | BWR | 1,100 | 28 November 1978 |
| " | Tsuruga 1 | Fukui Prefecture, Tsuruga City | " | 357 | 14 March 1970 |
| " | Tsuruga 2 | " | PWR | 1,160 | 17 February 1987 |
| Tohoku Electric Power Co. | Onagawa Atomic Energy 1 | Miyagi Prefecture, Ojika District, Onagawa Town, Ojika Town | BWR | 524 | 1 June 1984 |
| Tokyo Electric Power Co. | Fukushima First Atomic Energy 1 | Fukushima Prefecture, Futaba District, Ookuma Town, Futaba Town | " | 460 | 26 March 1971 |
| " | " 2 | " | " | 784 | 18 July 1974 |
| " | " 3 | " | " | " | 27 March 1976 |
| " | " 4 | " | " | " | 12 October 1978 |
| " | " 5 | " | " | " | 18 April 1978 |
| " | " 6 | " | " | 1,100 | 24 October 1979 |
| " | Fukushima Second Atomic Energy 1 | Fukushima Prefecture, Futaba District, Tomioka Town, Naraha Town | " | " | 20 April 1982 |
| " | " 2 | Fukushima Prefecture, Futaba District, Tomioka Town, Naraha Town | " | " | 3 February 1974 |
| " | " 3 | Fukushima Prefecture, Futaba District, Tomioka Town, Naraha Town | " | " | 21 June 1985 |
| " | " 4 | Fukushima Prefecture, Futaba District, Tomioka Town, Naraha Town | " | " | 25 August 1987 |
| " | Kashiwazaki Kariwa Atomic Energy 1 | Niigata Prefecture, Kashiwazaki City; Kariwa District, Kariwa Village | " | " | 18 September 1985 |
| Chubu Electric Power Co. | Hamaoka Atomic Energy 1 | Shizuoka Prefecture, Oryu District, Hamaoka Town | " | 540 | 17 March 1976 |
| " | " 2 | " | " | 840 | 29 November 1978 |
| " | " 3 | " | " | 1,100 | 28 August 1987 |
| Kansai Electric Power Co. | Mihama 1 | Fukui Prefecture, Mikata District, Mihama Town | PWR | 340 | 28 November 1970 |
| " | " 2 | " | " | 500 | 25 July 1972 |
| " | " 3 | " | " | 826 | 1 December 1976 |
| " | Takahama 1 | Fukui Prefecture, Ooi District, Takahama Town | " | " | 14 November 1974 |
| " | " 2 | " | " | " | 14 November 1975 |

**Table 1-11-4. Current State of Our Country's Nuclear Power Facilities (March 1989) (Continued)**

| Founder | Name of Power Plant | Location | Type of Reactor | Electrical Output (1000 kW) | Start of Operations |
|---|---|---|---|---|---|
| " | " 3 | " | " | 870 | 17 January 1985 |
| " | " 4 | " | " | " | 5 June 1985 |
| " | Ooi 1 | Fukui Prefecture, Ooi District, Ooi Town | " | 1,175 | 27 March 1979 |
| " | " 2 | " | " | " | 5 December 1979 |
| Chugoku Electric Power Co. | Shimane Atomic Energy 1 | Shimane Prefecture, Yataba District, Kashima Town | BWR | 460 | 29 March 1974 |
| " | " 2 | " | " | 820 | 10 February 1989 |
| Shikoku Electric Power Co. | Ikata 1 | Ehime Prefecture, Nishiuwa District, Ikata Town | PWR | 566 | 30 September 1977 |
| " | " 2 | " | " | " | 19 March 1982 |
| Kyushu Electric Power Co. | Genkai Atomic Energy 1 | Saga Prefecture, Higashi Matsuura District, Genkai Town | " | 559 | 15 October 1975 |
| " | " 2 | " | " | " | 30 March 1981 |
| " | Kawauchi Atomic Energy 1 | Kagoshima Prefecture, Kawauchi City, Hisamizaki Town | " | 890 | 4 July 1984 |
| " | " 2 | " | " | " | 28 November 1985 |
| Subtotal | | | 36 reactors | 28,701 | |
| **Under Construction** | | | | | |
| Hokkaido Electric Power Co. | Tomari 1 | Hokkaido, Yoshiji District, Tomari Village | PWR | 579 | June 1989 |
| " | " 2 | " | " | " | June 1991 |
| Tokyo Electric Power Co. | Kashiwazaki Kariwa Atomic Energy 2 | Niigata Prefecture, Kashiwazaki City; Kariwa District, Kariwa Village | " | " | October 1990 |
| " | " 3 | " | " | " | October 1993 |
| " | " 4 | " | " | " | July 1994 |
| " | " 5 | " | " | " | April 1991 |
| Chubu Electric Power Co. | Hamaoka Atomic Energy 4 | Shizuoka Prefecture, Oryu District, Hamaoka Town | BWR | 1,137 | September 1993 |
| Hokuriku Electric Power Co. | Shiga Atomic Energy | Ishikawa Prefecture, Hanesa District, Shiga Town | " | 540 | March 1994 |
| Kansai Electric Power Co. | Ooi 3 | Fukui Prefecture, Ooi District, Ooi Town | PWR | 1,180 | October 1992 |
| " | " 4 | " | " | " | August 1993 |
| Shikoku Electric Power Co. | Ikata 3 | Ehime Prefecture, Nishiuwa District, Ikata Town | " | 890 | March 1996 |
| Kyushu Electric Power Co. | Genkai Atomic Energy 3 | Saga Prefecture, Higashi Matsuura District, Genkai Town | " | 1,180 | July 1994 |
| " | " 4 | " | " | " | July 1998 |

**Table 1-11-4. Current State of Our Country's Nuclear Power Facilities (March 1989) (Continued)**

| Founder | Name of Power Plant | Location | Type of Reactor | Electrical Output (1000 kW) | Start of Operations |
|---|---|---|---|---|---|
| Subtotal | | | 13 reactors | 12,845 | |
| **Construction Planning in Progress** | | | | | |
| Tohoku Electric Power Co. | Maki Atomic Energy 1 | Niigata Prefecture, Nishikamahara District, Maki Town | BWR | 825 | FY 1999 |
| " | Onagawa Atomic Energy 2 | Miyagi Prefecture, Ojika District, Onagawa Town, Ojika Town | " | 825 | February 1997 |
| Tokyo Electric Power Co. | Kashiwazaki Kariwa Atomic Energy 6 | Niigata Prefecture, Kashiwazaki City; Kariwa District, Kariwa Village | " | 1,356 | July 1997 |
| " | " 7 | " | " | 1,356 | July 1999 |
| Subtotal | | | 4 reactors | 4,362 | |
| Total | | | 53 reactors | 45,908 | |
| **Development Class** | | | | | |
| PNC | Advanced thermal converter reactor prototype "Fugen" | Fukui Prefecture, Shiga City, Meishin Town | ATR | 165 | 20 March 1979 |
| " | FBR prototype "Monju" | Fukui Prefecture, Shiga City, Shiraki Town | FBR | 280 | |

(Notes) GCR: Gas-cooled reactor
BWR: Boiling water reactor
ATR: Advanced thermal converter reactor
FBR: Fast breeder reactor

### 3. Establishing the Nuclear Fuel Cycle

The basic guidelines of our country's nuclear fuel policies aim at ensuring and effectively utilizing a stable nuclear fuel supply and establishing nuclear fuel cycle independence that is consistent as a nuclear power generation system.

Thus, it is our business to strive for the early establishment of a nuclear fuel cycle: to accelerate the development and import of uranium resources, to begin domestic production of enriched uranium, to reprocess spent fuel, to develop radioactive waste processing and disposal technology.

#### (1) Natural Uranium

Although our country is currently guaranteed, through long-term overseas contracts, enough natural uranium to last until about the year 2000, we must make new provisions for the amounts that will be be needed afterwards. To that end, it is our business both now and in the future to facilitate the continuation of purchase agreements and, aiming for guaranteed natural uranium from development and import efforts, to promote overseas prospecting and development.

Based on these guidelines, the country uses the Power Reactor and Nuclear Fuel Development Corp. (PNC) to carry out overseas information gathering activities, to do prospecting surveys, and to conduct exploration work. Also, with respect to exploratory development by private organizations, the country is taking steps to further the Metal Mining Agency of Japan's payment-upon-success financing and guarantee of obligations, as well as financing for the Overseas Economic Cooperation Fund.

In FY 1988, the PNC conducted exploratory activities, either alone or in cooperation with overseas organizations, in places such as Canada, Australia, African countries, and China.

Additionally, passing these results on to the private sector is important, too, and, as projects unfold, the degree of private-sector participation increases. We are devoting ourselves to furthering studies on concrete policies on these and other kinds of situations where results are handed over to private industrial groups.

On the other hand, the private sector was also active in FY 1988: Shukkokosan carried out exploratory activities in Africa and Australia; the Overseas Uranium Resources Development Co. and the Japan-Australia Uranium Resources Development Co. implemented development and import activities in the Republic of Niger and Australia, respectively.

**(2) Uranium Enrichment**

With respect to the uranium enrichment services needed for our country's nuclear power generation, amounts required until about the year 2000 are currently guaranteed by domestic supplies and by long-term contracts between members of electric enterprises and members of American and French enrichment enterprises.

Not merely from the standpoint of ensuring a stable supply of enriched uranium in our country, but also from the standpoint of guaranteeing total independence of the nuclear fuel cycle, including plutonium utilization, we are devoting ourselves to furthering domestic uranium-enrichment start-up enterprises now and in the future and are increasing the percentage of domestically supplied enriched uranium, while continuing to take costliness into account.

The PNC has been at the center of domestic enriched-uranium production, promoting uranium enrichment based on a centrifugal separation method. Its prototype plant, which becomes the bridge to commercial plants, commenced the first unit of operations (100 ton SWU/year) in April 1988. Moreover, in terms of commercial plants, the Japan Nuclear Fuel Industries Co., having received national authorization in August 1988, is now pushing forward with construction in Rokkasho Village, Aomori Prefecture.

Furthermore, in order to improve the economic characteristics of uranium enrichment now and in the future, we are promoting the following efforts in connection with new enrichment technology.

1. Development, based on the coordinated cooperation of the government and the people, of high-performance centrifuges that employ new materials
2. Regarding atomic laser methods, long-term basic R&D at JAERI, supplemented with concentrated R&D by the private sector (the Laser Enrichment Technology Research Association)
3. Regarding molecular laser methods, engineering demonstration test R&D and basic R&D at RIKEN and PNC
4. Experimentation for gaining insights into the practical application of chemical methods

**(3) Reprocessing**

From the perspective of effective nuclear fuel utilization, spent-fuel reprocessing is said to be a "vital part" of the nuclear fuel cycle, and carrying out domestic reprocessing is considered to be a basic policy.

Along these lines, the PNC has built and is operating our country's first reprocessing plant in Tokai Village, Ibaraki Prefecture (processing capacity: 0.7 tons of uranium per day, processing method: purex method). The plant has been in operation since January 1981. It processed 19 tons of fuel for light water reactors in FY 1988, and by March 1989 the accumulated processing amount was approximately 392 tons.

Regarding private reprocessing plants, the Japan Nuclear Fuel Service Co. is now pushing forward with the various preparations for construction of a LWR-fuel reprocessing plant, with a yearly processing capacity of 800 tons, at Rokkasho Village, Aomori Prefecture. In March 1989, the company applied for designation as a national project.

Furthermore, with experience gained at the Tokai reprocessing plant as a basis, R&D work on reprocessing technology for high-speed reactor fuels is being pushed forward at the PNC.

(From the Nuclear Fuel Division of the Atomic Energy Bureau)

**(4) Plutonium Utilization**

In order to effectively utilize uranium resources and increase the supply stability of nuclear power generation, our country is aiming, in the long run, to establish a plutonium utilization system that is superior to uranium utilization in LWRs in terms of its safety and economical characteristics. Plutonium obtained from reprocessing is considered to be the basis for use in FBRs, which are remarkably superior in terms of efficient utilization of uranium resources. However, until FBRs can be put to practical use, we are working on plutonium utilization in LWRs and in ATRs from the perspective of establishing a broad plutonium-utilization technology base that will be needed in the future age of FBRs. At the current stage of LWR-based plutonium utilization, minor-scale demonstration plans are being promoted.

R&D work on processing technology for MOX fuels, which are needed for these reactors, is being promoted by the PNC. Operations of fuel processing facilities for the "Monju" FBR prototype reactor (which uses 5 tons of MOX per year) are progressing, based on the experience gained through the construction and operations of fuel processing facilities for the "Fugen" ATR and "Joyo" FBR prototype reactors.

Furthermore, construction of fuel processing facilities for an ATR demonstration reactor (40 tons per year) is progressing.

(From the Nuclear Fuel Division of the Atomic Energy Bureau)

**4. Radioactive Waste Processing and Disposal**

Radioactive waste processing and disposal measures, based on the Atomic Energy Commission's "Long-Range Nuclear Power Development and Utilization Plan" that was revised in June 1987, are being promoted as follows.

1. Low-Level Radioactive Wastes

Regarding land disposal, a plan is being promoted to dispose low-level radioactive wastes, in a concentrated fashion, in nuclear power plant sites. In concrete terms, the Japan Nuclear Fuel Industries Co., which was founded by core members of the electric industry, is planning to build a land disposal facility in Rokkasho

Village, Aomori Prefecture. The Science and Technology Agency is carrying out safety studies on the waste treatment facility project, for which the company submitted an application in April 1988 for approval, based on the Nuclear Reactor Control Law. Additionally, the Japan Atomic Energy Research Institute is at the center of land-disposal-related experimental research that is being carried out.

As for ocean disposal, under existing policies from the past which, regardless of the apprehension of concerned countries, do not enforce [any laws], it is our business to cautiously deal with those enforcements.

2. High-Level Radioactive Wastes

Regarding high-level radioactive wastes produced by PNC's Tokai reprocessing plant, liquid wastes are now safely being stored in tanks.

Also, the Japan Nuclear Fuel Service Co. is moving forward with plans to build a storage facility on the site of the planned reprocessing plant in Rokkasho Village, Aomori Prefecture. The storage facility is for high-level radioactive wastes that are generated as a result of overseas reprocessing consignments, and are expected to be returned to our country. The application for approval of this project was submitted to the nation in March 1989.

The original policy for high-level radioactive waste disposal was to vitrify the wastes into a stable form and, after storing them for 30 to 50 years so that they cool, to dispose of them in geological strata several hundred feet deep. R&D work on vitrification technology, solidified waste storage technology, and geological disposal technology is conducted mainly by the PNC, who began construction of a vitrification plant in June 1988.

(From the Nuclear Fuel Division and the Radioactive Waste Control Office of the Atomic Energy Safety Division, both of the Atomic Energy Bureau)

## 4. Rounding Out the Nuclear Non-Proliferation System

### (1) International Trends Surrounding Nuclear Non-Proliferation

Ever since India's nuclear experiments in 1974, apprehension over the global spread of nuclear technology has been growing, and trends have intensified towards the prevention of nuclear proliferation. Examples of these trends include the nuclear power policies of the Carter administration era in the US and the uranium-export policies of the two large uranium-producing countries, Canada and Australia.

In the midst of this kind of situation, the International Nuclear Fuel Evaluations (INFCE), called for by ex-President Carter, were held for over two years starting in October 1987. During this time, a conclusion entitled "Based on the Effective Application of Safegurads, Nuclear Power for Peaceful Use and Nuclear Non-Proliferation are Compatible" was reached.

Now that this conclusion has been accepted, in binational and multinational conferences, which reflect the new international order in relation to the peaceful use of atomic energy and nuclear non-proliferation, new regimes are investigated and improvements in safeguards technology are promoted.

1) Japan-US Conferences on Nuclear Power

During top-level meetings between Japan and the US in May 1981, working towards an immediate and permanent solution to the problem of the Japan-US reprocessing problem was mutually agreed upon. The results of meetings between Japan and the US from July 1981 onwards, the signing of a joint settlement on 30 October 1981, and a joint declaration were announced.

In June 1972, Nakagawa, former minister of the Science and Technology Agency, visited the US. Through general agreement formalities, mutual agreements were reached on solutions to the problems between Japan and the US in connection with reprocessing. This was followed by business-level meetings that started in August 1972, and culminated in the signing of a new agreement in November 1987, which came into effect in July 1988.

2) Multi-National Conferences in Connection with International Systems

Using the INFCE conclusions as a basis, the IAEA is conducting studies on concrete international systems for nuclear non-proliferation. Among these, conclusions have been tentatively reached on International Plutonium Storage (IPS) and International Spent-Fuel Management (ISFM), but supply countries and developing countries are at odds with each other over nuclear fuel supply assurance (CAS), and their meetings have fallen into a state of recess.

(From the Research and International Affairs Division of the Atomic Energy Bureau)

### (2) Maintaining Domestic Safeguard Systems

1. Safeguard Systems in Our Country and their Maintenance

Our country's nuclear power R&D and utilization has been strictly limited to peaceful objectives, in accordance with the spirit of the Basic Atomic Energy Law, since the beginning of its development. In June 1976, the Nuclear Weapons Non-Proliferation Treaty (NPT) was ratified, and, in conformity with the NPT, a safeguards agreement with the International Atomic Energy Association (IAEA) was concluded in December 1977. This agreement is for preventing any of the nuclear materials used in our country from being converted into nuclear weapons or any other nuclear explosive devices. Therefore, in view of the need for our country to work harder to maintain domestic safeguard systems, we revised the Nuclear Reactor Control Law, and in December 1987 appointed the Nuclear Materials Management Center as a designated information processing organization to process safeguards-related information and to implement data analyses.

2. Status of Domestic Safeguard Systems Enforcement

In conformity with the Nuclear Reactor Control Law, each nuclear power facility is equipped with recording equipment to monitor amounts of materials and is assigned tasks such as producing measurement-control reports and complying with spot inspections. National inspection authorities conduct periodical spot inspections and carry out inspection activities, such as checking accounts, mounting surveillance cameras and seals, and supplying and eliminating samples.

The facilities that were the main safeguard subjects in 1988 were 38 electricity-generating nuclear power plants, 5 processing facilities, 3 reprocessing and plutonium fuel processing facilities, 24 research reactor and critical test devices, 13 R&D facilities, 1 enrichment plant, and 4 other facilities. It was recognized from the results of enforcing these safeguards that there was no unusual data indicating that nuclear materials were used for anything other than peaceful objectives.

Also, in conformity with Japan-IAEA Safeguards Agreement protocol, the ninth meeting of the Japan-IAEA Joint Committee on Safeguards was held in May 1988, and coordination was carried out for the purpose of harmonious safeguards enforcement.

Additionally, regarding the control of nuclear materials specific to individual supplying countries that is carried out as services of bi-national nuclear power cooperation agreements, from the viewpoint of more harmonious enforcement of agreements such as the new Japan-US Nuclear Power Cooperation Agreement, which entails the duties of increasingly rigorous and detailed measurement-control of nuclear materials, regulations on the use of internationally regulated commodities were revised and the necessary regulation preparations, such as measurement control for each of the supplying countries, records, and reports, were carried out.

**(3) Safeguards Technology R&D**

In November 1981, our country, following others such as America, England, Australia, Germany, and Canada, started a plan to support IAEA safeguards (JASPAS). In FY 1988, 29 projects on safeguard systems, containment and surveillance technology, etc., were pushed forward.

On the other hand, regarding bi-national cooperation, informal meetings about safeguards were held between Japan and the US, and other such broad idea exchanges were conducted on international safeguards-related problems.

**(4) Maintaining Nuclear Materials Protection Systems**

In facing the actualization of nuclear fuel cycle enterprises, the amounts of nuclear materials that are handled in nuclear power plants and the occasions for their transport are expected to increase in our country. Therefore, it is vitally important that we continue to devise appropriate protection measures for nuclear materials, both now and in the future.

Internationally as well, the protection of nuclear materials is recognized as a basic requisite in nuclear power activities, and adopting appropriate protection measures is becoming an international obligation.

Our country's nuclear materials protection measures that are enforced today have their basis in the Atomic Energy Commission's 1981 decisions, and these measures virtually fulfill IAEA and other guidelines. In looking back at the treaty on nuclear materials protection that came into effect in February 1987, when the time came to sign the treaty, our country, which deals with the problems of nuclear materials protection, made clear our policy intentions, both at home and abroad and, during the 112th Diet assembly in May 1988, brought into existence the partially revised law entitled "Raw Nuclear Materials, Nuclear Fuel Materials and Nuclear Reactor Regulatory Law." The objective of this law is to provide the measures required in domestic laws using the aforementioned perspectives as a basis. Afterwards, progress was made in preparing the ordinances needed for enforcement of this law. In November 1988, revisions which included establishing standards for protection of in-transit nuclear materials, etc., were finalized, and the treaty on protection of nuclear materials was signed.

(From the Safeguards Division of the Nuclear Safety Bureau)

**5. Promoting Advanced Reactor R&D**

**(1) Power Reactor Development (FBR and ATR R&D)**

Established in 1967, the Power Reactor and Nuclear Fuel Development Corp. (PNC) carries out the basic policies and plans in connection with power reactor development operations that are established by the Prime Minister through resolutions of the Atomic Energy Commission.

1) Fast Breeder Reactor R&D

Because the epoch-making FBR, which produces more nuclear fuel than it consumes during power generation, can make the greatest possible use of uranium resources, it can basically solve the problem of nuclear fuel resources. Some think that the FBR should become the mainstream of nuclear power generation in the future.

In our country, the PNC, in conformance with the aforementioned policies and plans, has been eagerly promoting the development of a sodium-cooled FBR which uses a mixed uranium and plutonium oxide as fuel.

The purpose of the "Joyo" demonstration reactor, our country's sodium-cooled FBR, is to accumulate technical experience with FBRs from work on its design, construction, and operation, and to use it as a radiation facility for fuel materials. Currently, in rated operation with a heat output of 100,000 kW, irradiation experiments on various fuel materials are being conducted.

The purpose of the "Monju" prototype reactor is to verify FBR technical performance and reliability, and, from work on its design, construction, and operation, to derive cost criteria for use as a power-generating reactor in the practical reactor class of the distant future.

Procedures for approval, in compliance with local construction agreements, of the prototype reactor "Monju" (electrical output: 280,000 kW) were conducted in May 1982, and construction of a road along the seacoast was started in January 1973.

Authorization for the first design and construction methods was received in August 1985, and actual construction was underway in October 1985. Currently, earnest construction is progressing, aiming for criticality by 1992. Incidentally, an act of nullity lawsuit on official license procedures for setting up the "Monju" reactor and a lawsuit for prohibiting the construction and operations of the reactor were brought before the Fukui Area Court in September 1985.

R&D centered on sodium-related facilities of the PNC's Ooari Engineering Center and steam-generator test facilities is being vigorously promoted.

Also, technical exchanges with overseas research organizations, centering on Europe and the US, are being actively conducted.

Incidentally, members of electrical industries transferred control of services related to demonstration reactors to the Japan Atomic Power Co. in December 1985 and decided to aim at improving the technical position of demonstration reactors.

Together with this, the "FBR R&D Management Committee," formed by the PNC, Japan Atomic Power Co., JAERI, and the Electric Power Central Research Institute, was launched in July 1986 for the purpose of efficiently promoting R&D work on post-demonstration-reactor FBRs.

2) Advanced Thermal Converter Reactor R&D

ATRs are characterized by their ability to effectively and easily utilize not only plutonium but inferior uranium and diminished uranium as well. This is the type of reactor that is being independently developed in our country.

Since the "Fugen" prototype reactor (electrical output: 165,000 kW) began actual operations in March 1979, operations have been, for the most part, running smoothly. Progress is being made with this reactor in terms of the R&D and operational experience gained from it, which influences the design of demonstration reactors, and the accumulation and evaluation of data.

The Electric Power Development Co., which is the nucleus of demonstration reactor construction and operations, implemented local environmental impact studies in Ooma Town, Aomori Prefecture, a planned construction site, and began basic design work in January 1984. Based on the developments in these local environmental impact studies and basic design, the ATR Demonstration Reactor Construction Promotion Committee decided in May 1985 that operations would start in March 1998. Upon acceptance of this decision, the Electric Power Development Co. submitted a request to the local authorities for cooperation in the construction of the demonstration reactor. Afterwards, based on the local state of affairs, the ATR Demonstration Reactor Construction Promotion Committee put the start of operations at March 1999. In parallel with this, preparations of cross-check codes were enforced on a priority basis for R&D and safety investigations on demonstration testing of equipment needed in the development of the reactor.

(From the Power Reactor Development Division of the Atomic Energy Bureau)

**(2) High-Temperature Engineering Testing and Research**

With the Japan Atomic Energy Research Institute (JAERI) at the center, progress has been made in our country's high-temperature gas reactor R&D. JAERI conducts R&D work on high-temperature gas reactor element technology by performing demonstration tests of heat transmission and heat flow from high-temperature helium to various structures, critical experiments, fuel element irradiation tests, etc.

In view of the present-day energy situation, the consumption trends in the utilization of nuclear fuel processes, and other changes in the social conditions surrounding high-temperature gas reactors, the Atomic Energy Commission established the High-Temperature Gas Reactor Research and Develpoment Program Specialists Section in March 1986, conducted studies on ways to promote high-temperature gas reactor R&D both now and in the future, and put together a report in December 1986. In acceptance of this report, the new long-term program revises the plans to construct an experimental reactor as the first stage in the practical application of existing high-temperature gas reactors. The new plan calls for the construction of a high-temperature engineering test research reactor, with which diversified test research can be conducted; it aims for sophistication and the establishment of a technology base for high-temperature gas reactors, and promotes leading-edge, basic high-temperature research.

Based on this kind of reasoning, JAERI carried out the design for a high-temperature engineering test research reactor and applied for official license to establish the reactor on 10 February 1989. (From the Administrator of Atomic Energy Institutes of the Atomic Energy Bureau)

**6. Nuclear Powered Ship R&D**

Larger vessel output, higher speed, long-term continuous sailing, and underwater navigation are difficult to achieve with conventional ships, but are possible with

nuclear powered ships. These characteristics are seen as largely contributing to sophistication in ocean present-day and future transport.

To our country—surrounded on four sides by water, increasingly more reliant on overseas trade, having to support the people's lifestyles and economic activities—it is necessary to work towards accumulating and cultivating technology, knowledge, and experience in connection with nuclear powered ships, to the point of being able to appropriately cope with future needs when they arise.

From this kind of perspective, we are devoting ourselves to promoting gradual and steady R&D efforts on nuclear powered ships, in conformance with the "Basic Program for the Research Needed to Develop the Japan Atomic Energy Research Institute's Nuclear Powered Ships," which the government established in March 1985. We will also promote R&D using the "Mutsu" nuclear powered ship and improved research on ship reactors, aiming at increasing the reliability and lowering the costs of these reactors.

An experimental voyage of the "Mutsu" will be conducted for about one year for the purpose of obtaining the knowledge and data that is needed for present-day and future ship reactor R&D. In FY 1988, construction of a new on-shore facility at the Port of Sekinehama continued from the year before, and by the end of the year the entire facility was nearly completed. Also, inspection of the ship's reactor container cover release was begun in August 1988. In November 1988, the reactor container cover was released for the first time in 16 years, and since then inspections and maintenance work have been carried out on the nuclear fuel and on the interior structure of the reactor.

Design research, for the purpose of establishing the concept of the superiority of ship reactor in terms of cost and reliability, has been implemented, and actualization of the next and future R&D stages, based on the results of the design research and results of R&D using "Mutsu," was decided upon. In FY 1988, design and evaluation research in connection with the future ship reactor concept and the necessary experimental analysis research were implemented. Also, progress was made in "Nuclear-Powered Ship Engineering Simulation" research, which anaylzes the motion characteristics of nuclear-powered ships in diverse operational states.

| "Mutsu" Summary | |
|---|---|
| Launch | 12 June 1969 |
| Overall length | 130.0 m |
| Width | 19.0 m |
| Depth (Up to upper deck) | 13.2 m |
| Total tonnage | 8,242 tons |
| Fully loaded displacement | 10,383 tons |
| Reactor type | Pressurized water reactor (separation type) |
| Thermal output | 36 MW |
| Export power (greatest/ordinary use) | 10,000/9,000 horsepower |
| Speed (greatest/ordinary use) | 17.0/16.5 knots |

(From the Administrator of Atomic Energy Institutes of the Atomic Energy Bureau)

## 7. Nuclear Fusion R&D

Because it makes possible a semi-permanently stable energy supply due to its use of deuterium, which is abundantly available in seawater, as a fuel, realization of the early stage of nuclear fusion is hoped for. Nuclear fusion R&D has been promoted in conformance with the "Basic Program for the Second Stage of Nuclear Fusion R&D," which was drafted by the Atomic Energy Commission in July 1975.

These R&D efforts are carried out primarily by JAERI, with some of the work allocated to the Electrotechnical Laboratory and the National Research Institute for Metals.

Nuclear fusion R&D, which extends over large scales and long terms, must include universities and must be comprehensively and effectively promoted. For these reasons, the Nuclear Fusion Council was established under the direction of the Atomic Energy Commission in November 1975. From the perspective of promoting our country's nuclear fusion R&D in a comprehensive and planned fashion, the council is striving for the coordinated cooperation of universities and other related groups and is conducting studies on R&D policies.

After the goal of attaining critical plasma conditions with the "Critical Plasma Test Device (JT-60)," the main project of the second-stage program at JAERI, was achieved in September 1987, the device was rebuilt, and pellet incidence and other high-performance experiments (I) progressed. The results of this experimentation, such as the realization of a new confinement mode (improved diver mode), provided new knowledge in plasma physics. In the experiments with the high-performance tokamak development test device (JFT-2M), new knowledge was gained on continual plasma operations. From the Doublet III joint experiment by Japanese and American collaborators, too, pioneering results were obtained in connection with the performance of plasma confined in a non-circular reactor core during post-vacuum-container-enlargement heating experiments.

In addition to these, R&D efforts were promoted in superconducting magnet technology, tritium technology, materials, and other related technology.

In international cooperative activities, joint projects such as the Doublet III experiments, irradiation research, tritium engineering, etc., as well as researcher and information exchanges have been carried out over a broad range, under the direction of the Japan-US Nuclear Fusion Regulation Committee.

R&D cooperation is continuing to unfold in the International Energy Association (IEA), an economic cooperative development organization.

Also, joint collaboration by Japan, the EC, America, and the USSR on the international thermonuclear fusion experimental reactor (ITER) was started in April 1988, under the direction of the IAEA.

**JT-60 Principle Materials**

| | | |
|---|---|---|
| Torus plasma radius(principle radius) | (m) | 3.0 |
| Plasma cross-section radius | (m) | 0.95 |
| Toroidal magnetic field | (T) | 4.5 |
| Plasma current | (MA) | 2.7 |
| Intermittent period for above | (sec) | 5 -10 |
| Neutron incidence heat output | MW | 20 |
| High-frequency heat input | MW | 10 |
| Torus device diameter | (m) | 15.0 |
| Torus device height | (m) | 13.0 |
| Torus device net weight | (t) | 5,000 |

(From the Technology Development Division of the Atomic Energy Bureau)

## 8. Radiation Utilization

### (1) Radiation Utilization Policies

The development of practical applications in the utilization of radiation in fields such as agriculture, manufacturing industries, and medicine, as well as R&D in various fields, is actively promoted at JAERI and national test research institutions such as the National Institute of Radiological Sciences.

Regarding the present and future directions of radiation utilization, following the acceptance of the report put together by the Radiation Utilization Specialists Section of the Atomic Energy Commission in February 1987, the Atomic Energy Commission adopted the Long-Term Plan for the Development and Use of Nuclear Power (June 1988), which indicates that "the emphasis in R&D will be placed on the creation of sophisticated technologies, such as new beam generation and utilization technology and tracer technology, that will open new doors to nuclear power utilization and will contribute to a broad range of science and technology."

### (2) Agricultural Uses

The use of radiation in agriculture extends over a wide range of fields: food irradiation, pest control, plant breeding, and various kinds of experimental research. Food irradiation involves the use of radiation to kill insects and germs and to prevent sprouting; its purpose is to extend the period over which food can be stored. In conformance with the "Basic Program for Food Irradiation Research and Development," which the Atomic Energy Commission adopted in 1967, R&D efforts involving seven types of foods, including potatoes and onions, has been promoted at JAERI and at concerned national test research institutions.

As a result, irradiation for the purpose of preventing sprouting was approved for potatoes in 1972, and the application of irradiation has been put into practice. Afterwards, results of research on onions, rice, wheat, Vienna sausage, fish paste, and tangerines were gathered and made available to the public.

As for pest control, the sterile-insect-release-method for eliminating harmful insects, where large quantities of harmful insects that were sterilized with radioactive radiation are let loose in fields, has been applied and is successful in eradicating melon flies in Hisagome Island, Okinawa Prefecture.

Plant breeding is being carried out on agricultural products, such as rice and barley, and forest trees, such as cedar and pine.

In addition, the use of tracers (in physiological and ecological research, improving fertilization methods and agricultural chemical usage methods, underground water investigations, etc.) and activation analysis techniques (detection and measurement of trace components) as radiation utilization is promoted in experimental research having to do with agriculture, forestry, and fisheries.

### (3) Industrial Uses

The use of radiation in manufacturing extends over a broad range of industries that includes chemistry, paper pulp, iron and steel, machinery, ship building, and others. Techniques for employing radiation also branch out in many directions such as gauging, tracers, analysis and measurement, and nondestructive testing.

Many of the uses of radiation in gauging, as an important sensor employed in thickness, level, density and other

process control measurements, are incorporated into automatic control systems. Gas chromatography equipment that uses petroleum sulfur analysis measurements and a $^{63}$Ni radiation source plays a large role in environmental preservation as a method for analytically measuring environmental pollutants.

In nondestructive testing, X-ray and γ-ray transmission test methods have been widely employed for many years in testing welded sections. Recently, though, computer tomography (CT) methods are gaining attention and their use is continuing to spread. Thermal neutron radiography R&D is becoming popular, and is being applied in some nuclear fuel rods and space vehicles materials. As a part of advanced radiation utilization research based on the Long-Term Plan for the Development and Use of Nuclear Power that was adopted in June 1988, applications such as element-specific imaging, which takes advantage of neutrons that are outside of the range of the pulse-like heat from an accelerator, continue to be taken up.

As for uses in tracers, in addition to using $^{83}$Kr for testing the airtightedness of semiconductor electronic parts, radioactive isotopes have employed in development tests for a variety of electronic parts.

Research and development in connection with the utilization of radiation in manufacturing has been implemented mainly at the JAERI Takasaki Research Institute. Here the development of functional polymer materials, aimed at applications in selective films and slow-acting pharmaceuticals, smoke processing, and other research on radiation utilization with respect to environmental preservation is being carried out. Furthermore, as a part of advanced radiation utilization research, construction and maintenance of large ion-radiation research facilities is progressing. These facilities are needed for promoting space development and nuclear fusion reactor materials R&D based on ion beams, biotechnology, research on new functional materials, etc.

**(4) Medical Uses**

Utilization of radiation in medicine takes two forms: beams and radioisotopes. It can also be classified according to objective, radiation: radiation used for diagnosis and for treatment. One of the uses of beams for diagnostic purposes is x-ray diagnosis. X-ray diagnosis is used in every area of clinical medicine; currently, the demand is as high as 300 million cases of x-ray usage per year. Computer tomography (CT), in which computers bring image processing to a high level of quality, plays a leading role as another way in which beams are employed for diagnostic purposes. CT has greatly influenced not only medicine but the industrial world as well.

Among the uses of beams for purposes of medical treatment, the object of the treatment is limited to malignant tumors, but the radiation sources are divided into those treatments that employ radioisotopes, such as $^{60}$Co and $^{192}$Ir, and those which employ accelerators, such as the linear accelerator microtron. The beams are primarily either x-rays or γ-rays; very small electron beams are employable. More than half of all cancer patients are receiving the benefits of beam treatment.

Incidentally, research on proton beams and fast neutron beams, and treatment methods involving thermal neutron capture, is being conducted at leading-edge organizations. Also, R&D aimed at cancer treatment using baryon beams, the so-called ultimate radiation treatment, is being conducted at the National Institute of Radiological Sciences.

Among the uses of radioisotopes for diagnostic purposes, there is in vivo testing, in which a radioisotope dosage injected into the body is examined, and in vitro testing, which employs test tubes. Rapid advances are being made in in vivo testing, due to advancements in today's computer-tomography-related scinti-cameras and progress in developments of tag compounds such as $^{99m}$Tc, $^{111}$In, and $^{123}$I. Also, starting with $^{11}$C, heretofore unusable, extremely short-lived nuclides that are useful elements for living organisms are gradually coming into use, and their use is starting to spread as a result of the development of small in-hospital synchrotrons. In this connection, research on the development of new tag compounds and improving positron-CT performance is being actively promoted, primarily at the National Institute of Radiological Sciences. Boosted by current advances in bioscience, the range of uses for in vitro testing, too, is expanding.

Among the uses of radioisotopes for treatment purposes, treatment involving the use of $^{131}$I for resisting the spread of disease in the thyroid membrane is superior to external treatment methods and treatments based on anti-thryroid-membrane medicines and is becoming the first treatment of choice. However, follow-up methods to that treatment have not yet been developed, and expectations are now growing for methods that involve tagging monoclonal antibodies with $^{90}$Y.

(From the Technology Development Division of the Atomic Energy Bureau)

**(5) New Trends in Radiation Utilization (Advanced Uses)**

Now, due to the advances in R&D related to accelerator, image processing, and other technologies, new trends in radiation utilization are gaining attention. For example, RIKEN employs heavy ions and π-mesons, and JAERI uses cold neutron baryon beams for elementary particle and atomic nucleus research, for development of new materials, and for development of advanced analysis and measurement technology. Also, cooperative R&D efforts at RIKEN and JAERI in connection with the next-generation radiation facilities for specialized use are being promoted.

## 9. Atomic Energy Safety Research

### (1) Engineering-Style Safety Research

In view of the importance of ensuring the safety of nuclear power facilities, safety standards and guidelines are being built upon the accumulation of the latest possible scientific knowledge and experience in nuclear power facility operations. Because minute and quantitative maintenance, which is adapted to the advancements in nuclear power facilities, is needed, safety research on nuclear power facilities is being conducted.

Building upon the safety research that is implemented by and allotted to government and private-sectors, and the safety research promotion systems, the Safety Committee's Safety Research Specialists Section conducts studies on systematic and comprehensive promotion policies, implements yearly safety research programs, and conducts assessment studies on research results. In the yearly safety research programs (FY 1987 - FY 1990) adopted by the Safety Research Specialists Section in September 1985, the following safety research subjects were listed as those which should be implemented now and in the future: water reactor (light-water and heavy-water reactors) safety, FBR safety, safety of reprocessing and nuclear fuel facilities, safety in transporting radioactive materials, safety of nuclear power facilities in resisting damage from earthquakes, safety assessments based on probability theory. The contents of and future directions for the six fields were described in the yearly programs.

Furthermore, parts of the programs were revised: in August 1986, the part on FBR safety research was changed; after 1987, additions were made; in March 1988, investigative reports on the Soviet nuclear power plant accident were received.

Now, research at each of the research organizations is implemented according to these programs.

In the research on water reactor (light-water and heavy-water reactors) safety, JAERI researchers are working on elucidating the phenomena that occur during loss of cooling accidents (LOCA), response interval accidents (RIA), and severe accidents, and are developing a safety analysis code for safety evaluations when these kinds of accidents occur. Also, the PNC is conducting research in connection with the soundness of ATR fuels. The National Research Institute for Metals is conducting research on the interaction between corrosion fatigue and the tentative strength of corrosion-fractures in metallic materials used in nuclear reactors. As LOCA-related research, JAERI is currently moving forward with the ROSA-IV program and is employing large, general test equipment in its research on minor-damage-warning LOCAs in pressurized-water.

As RIA-related research, experiments are being conducted within the Nuclear Safety Research Reactor (NSRR) on the behavior of fuels within the reactor when the reactivity increases abnormally and on the mechanisms which generate the destructive energy that accompanies fuel damage. The experiments that are now being continued involve irradiation tests on not-yet-irradiated fuel as well as on burnt-up fuel.

Additionally, international cooperation is also being actively promoted. We are participating in efforts such as the Harden Program and the SFD Program, and are managing the NSRR and ROSA-IV plans, which were established by JAERI, as international joint research. (Refer to Table 2-25)

In research on FBR safety, the PNC is conducting safety research on the subject large, post-demonstration reactors in connection with accident prevention and mitigation and the adoption of policies for evaluating design safety. The PNC is using facilities such as the "Joyo" reactor in its research.

In international cooperative efforts, the CEA (France's Atomic Energy Agency) and the KfK (West Germany's Karusurue Atomic Energy Research Center) are participating in the planning of in-reactor RIA simulation tests, and, in addition to gaining advantageous knowledge, periodic work on in-reactor testing to determine how accident damage spreads locally is continuing with the CEA.

As for research related to the safety of reprocessing plants and other nuclear fuel facilities, there is research in connection with criticality and shielding safety and accident assessment methods; radiation control technology, and analysis and measurement technology; and operations management, conservation, repair, and inspection technology. With RIKEN and PNC at the center, research on safety assessments and improvements are being carried out from both sides.

Safety research in connection with the transport of radioactive materials and research on the safety of nuclear power facilities with respect to how they hold up during an eqrthquake is primarily being implemented by the national test research institutions.

The PNC and RIKEN are at the center of research carried out in connection with nuclear power facility safety assessments that are based on probability theory. This research includes methods for assessing reliability, the stages and influences of nuclear power plant accidents, the reliability of human behavior, and methods for assessing external phenomena.

### (2) Safety Research on Environmental Radioactivity

As nuclear power utilization gets into its stride, from the standpoint of ensuring the health and safety of the nation, research on environmental radioactivity, such as estimated values and impacts of radioactive doses in the human body that are attributable to nuclear power plants, has become increasingly important. In order to promote, from a comprehensive and systematic perspective, the continual guarantee of coordinated cooperation

amongst all of the research organizations, the Environmental Radioactivity Safety Research Specialist Group of the Nuclear Safety Commission drafted the Yearly Program for Environmental Radioactivity Safety (March 1988, partially revised). Now, along the lines set forth in this year's program, comprehensive and programmatic research is being carried out by the National Institute of Radiological Sciences, at the center, and by JAERI, the PNC, and national test research institutions.

At the National Institute of Radiological Sciences, progress is being made in research for estimating the degree of danger in radiation sickness with respect to low doses and low dose rates of exposure to the human body. In order to conduct research on internal exposure to radiation from plutonium and other materials, the institute is performing experiments using radioisotopes in its internal-radiation-exposure test rooms. They are also conducting research in connection with evaluating doses of radiation exposure from environmental radioactivity.

At JAERI, research on methods for measuring and assessing amounts of environmental radiation, research on shifts in radioactive nuclides throughout the environment, and the development of environmental radioactivity assessment systems is being conducted.

The PNC is developing methods for analyzing trace amounts of radioactive nuclides in environments near nuclear fuel cycle facilities and methods for evaluating doses.

Also, investigative research on radiation sickness prevention is being promoted with funds such as the consignment funds for the peaceful utilization of nuclear power.

(From the Technology Development Division of the Atomic Energy Bureau)

### (3) Safety Research in Connection with Radioactive Waste Disposal

The ensurance of safety in connection with the disposal of radioactive wastes that are byproducts of nuclear power generation is vitally important. In coping with the actualization of present-day radioactive waste disposal programs, it is necessary to accelerate the research needed to maintain the safety standards, guidelines and assessment methods required by disposal-related safety regulations. Consequently, the Nuclear Safety Commission is drawing up yearly safety research programs.

Regarding low-level radioactive waste disposal, with both land and ocean disposal as the subjects, environmental simulation tests on land disposal are being conducted mainly by RIKEN. This testing is based on the "Yearly Safety Research Program for Low-level Radioactive Waste Disposal" (adopted in July 1983 and revised for the second time in August 1985), which was put together by the Radioactive Waste Safety Technology Specialist Group of the Nuclear Safety Commission.

On the other hand, safety research on high-level radioactive wastes and TRU wastes is carried out primarily by RIKEN and the PNC, based on the "Yearly Safety Research Program for High-level Radioactive Waste Disposal" (adopted in August 1985 and revised in August 1987), which was put together by the Radioactive Waste Safety Regulations Specialist Group of the Nuclear Safety Commission. This research work includes evaluating the reliability of man-made barrier system performance.

(From the Radioactive Waste Regulations Office of the Nuclear Safety Division of the Atomic Energy Commission)

### 10. Consignment of Research on the Peaceful Uses of Atomic Energy

Our country's development and utilization of atomic energy, which is focused on nuclear-powered electricity generation, is becoming commercialized, but, in order to promote that development and utilization in a long-term and harmonious fashion, it is necessary to push strongly for the development of independent technology. Our country's original research, such as research on the prevention of radiation sickness, is moving forward.

To accelerate nuclear power R&D, the nation must, of course, take the initiative and expand the development of the technology needed for pioneering research. At the same time, though, it is necessary to adopt positive policies which promote this kind of research in private-sector organizations as well.

Consequently, of the test research that should be implemented as a part of the nation's responsibility, it is thought that consigning this kind of research to the proper private-sector organizations can be more effective than conducting the research in national test research institutions. In this respect, research is being consigned.

As for the FY 1988 Consignment Funds for Research on the Peaceful Utilization of Atomic Energy, approximately ¥64 million was granted for 5 test research subjects that have to do with radiation sickness prevention. (From the Technology Development Division of the Atomic Energy Commission)

## Chapter 12. Intensification of Safety Measure Attendant upon Nuclear Power Development and Utilization

### 1. Ensuring the Safety of Nuclear Reactor Facilities

### (1) Safety Regulation Systems for Nuclear Reactor Facilities

Nuclear reactor safety regulations are based on the Nuclear Reactor Regulation Law. The Prime Minister coherently regulates test research reactors and reactors in

the R&D stage; MITI, nuclear reactors used for generating electricity; the Ministry of Transport, nuclear reactors used to power ships.

In concrete terms, the contents of the regulations cover: (i) official licensing for establishing (and modifying) nuclear reactor facilities; (ii) authorizing nuclear reactor facility design and construction methods; (iii) authorizing welding methods; (iv) enforcing welding inspections; (v) enforcing pre-use inspections; (vi) authorizing security regulations; (vii) enforcing periodic inspections; (viii) collecting accident reports and radiation management reports; (ix) regulating the dismantling of nuclear reactors.

Recently, in conformance with advice from each of the authoritative and administrative agencies, the Nuclear Safety Commission has been conducting investigative deliberations on the application of standards with respect to the licensing of nuclear reactor facilities as well as, when necessary, on important items that arise in the stages following licensing.

**(2) Enforcing Nuclear Reactor Facility Safety Regulations**

1) Official Licensing of Nuclear Reactor Facilities

In FY 1988, 7 licenses for establishing or modifying nuclear reactor facilities (including one case which was still under discussion at the end of March 1988) were granted by the Prime Minister.

Incidentally, the Nuclear Safety Commission is drafting 16 reports for licenses to establish or modify nuclear reactor facilities (of these, 9 are for electric power-generating reactors).

2) Authorizing Nuclear Reactor Facility Design and Construction Methods

In FY 1988, there were 45 cases of Science and Technology Agency-approved nuclear reactor facility design and construction method authorization.

3) Enforcing Pre-Use Inspections

Based on the Nuclear Reactor Regulation Law, pre-use inspections are carried out on nuclear reactor facilities before they are used for construction or performance (also applicable to the case of modifications made to a facility).

In FY 1988, the Science and Technology Agency conducted 52 pre-use inspections.

4) Welding Method Authorization and Welding Inspections

Authorization of methods by which the interior of nuclear reactors are welded together and inspections of that welding are carried out in conformance with the Nuclear Reactor Regulation Law. In FY 1988, there were 49 cases of welding method authorization and 290 welding inspections handled by the Science and Technology Agency. Incidentally, after December 1986, instead of the Science and Technology Agency, the Atomic Energy Safety Technical Center, an inspection organization appointed by the Prime Minister, enforced welding inspections.

5) Periodic Inspections

Once every year performance inspections are conducted in nuclear reactor facilities.

In FY 1988, the Science and Technology Agency conducted 22 periodic inspections.

6) Nuclear Reactor Facility Accident Reports

In conformance with the Nuclear Reactor Regulation Law, 8 cases of nuclear reactor facilities being out of order were reported to the Science and Technology Agency.

**(3) Safety Assurance Based on International Cooperation**

1) International Atomic Energy Association (IAEA) Activities

The primary IAEA activities related to the safety of nuclear power involve cooperation in adopting nuclear safety standards (the NUSS program), holding a variety of specialists' meetings, exchanging information, etc.

As for the NUSS program, 55 safety guidelines and 5 standards were in place until 1985 in the following 5 fields: 1) government systems, 2) site safety, 3) safe design, 4) safe operations, and 5) quality assurance. The 1986 Chernobyl accident, however, prompted a review of these standards. The revisions were completed in June 1988 and further, successive revisions are underway.

Also, experts from our country are participating in and contributing to the International Nuclear Safety Advisory Group (INSAG), the International Radioactive Waste Management Advisory Committe (INWAC), and efforts to revise safety regulations on radioactive material transport.

2) Organization for Economic Cooperative Development/Nuclear Energy Association(OECD/NEA) Activities

Aiming for greater cooperation in the peaceful utilization of atomic power, the OECD/NEA conducts information exchanges and investigates problems in technical cooperation, administration, and regulation, but its subordinate organizations, the Committee for the Safety of Nuclear Power Institutions (CSNI) and the Committee for Radiation Protection and Public Health (CRPPH), have become the centers for activities in the field of atomic energy safety. Our country, as an advanced nation, has been actively participating in the activities of both committees and has been making contributions to the efforts of the committees by dispatching suitable

experts, putting together reports, etc. In June 1988, our country's Nuclear Safety Commission director, Uchida, attended the second round of top-level meetings on atomic energy regulation, where the brains in charge of each country's regulations exchanged opinions.

3) Exchange of Information on Regulations between Japan and the US

The settlement with the US on information exchange in connection with nuclear plant regulations, which was concluded on 30 May 1974, is still in effect after extensions were made in September 1983 and December 1985. In FY 1988 as well, energetic activities, including human exchange, were carried out.

4) Exchange of Information on Regulations between Japan and France

In March 1979, a settlement was concluded with France on information exchange in connection with nuclear plant regulations. Based on this settlement, energetic activities, including human exchange, were carried out in FY 1988 as well.

**(4) Adopting Guidelines for Nuclear Reactor Facility Safety Inspections**

The Nuclear Safety Commission, since its inception in October 1978, agrees to use the guidelines decided upon by the Atomic Energy Commission. Henceforth it will draft more new guidelines and will successively revise existing guidelines to conform with the latest scientific knowledge. Its Nuclear Reactor Safety Standards Specialist Section conducts investigations and deliberations.

In FY 1988, "Guidelines for Evaluating Reactor Core Heat Design in Power Generating Pressurized Water Reactors" and "Thoughts on Safety Demonstration Evaluations of ATR Demonstration Reactors" were drafted, and continued revisions were made to guidelines for safe-design inspections and safety evaluations. Also, due to the influence of new ICRP recommendations (Pub. 26), related guidelines were partially revised.

(From the Nuclear Reactor Facility Inspection Office of the Reactor Regulation Division of the Nuclear Safety Bureau)

(From the Safety Studies Office of the Nuclear Safety Division of the Nuclear Safety Bureau)

**2. Comprehensive Safety Assurance for the Nuclear Fuel Cycle**

**(1) Nuclear Fuel Cycle Safety Regulation System**

The Science and Technology Agency consistently regulates the so-called nuclear fuel cycle—the processing of nuclear fuel substances, the reprocessing of spent fuels, the use of plutonium and other fuels, the transport of nuclear fuel substances. However, the Nuclear Safety Commission double-checks the results of the Science and Technology Agency's safety inspections at processing and reprocessing facilities.

**(2) Safety Regulation Enforcement in Nuclear Fuel Cycle-Related Facilities**

For nuclear-fuel-cycle-related facilities, each enterprise's designation and licensing, as well as authorization of design and construction methods for each facility, is regulated in accordance with the Nuclear Reactor Regulation Law.

1) Reprocessing Facilities

The PNC Tokai plant is currently our country's only reprocessing facility. In addition to granting approval for one case of plant modifications for the Tokai facility, 30 cases of approval for construction methods were authorized in FY 1988. Also, the fifth periodic inspection of the facility commenced on 23 February 1989.

2) Safety Regulations for Nuclear Fuel Substance Use and Processing Enterprises

As for nuclear-fuel-processing enterprises, the Japan Atomic Fuel Industry Co.'s Rokkasho uranium-enrichment plant was licensed on 10 August 1988, and currently, at the end of FY 1988, 6 companies and 8 enterprises are obtaining licenses.

Currently, at the end of FY 1988, 152 enterprises are obtaining license to use nuclear fuel materials.

3) Safety Regulations for Transporting Nuclear Fuel Substances

Safety regulations for overland transport of nuclear fuel materials are enforced by the Science and Technology Agency, the Ministry of Transportation, and local and prefectural public security commissions in accordance with the Nuclear Reactor Regulation Law. Safety regulations for marine transport are enforced by the Maritime Safety Agency in accordance with the Maritime Safety Act. Safety regulations for air transport are enforced by the Ministry of Transportation in accordance with the Aviation Act.

Currently, at the end of March 1989, there are 74 forms for nuclear fuel transport plans and 11,346 transport containers that were approved by the director-general of the Science and Technology Agency. Also, there were 16 forms for nuclear fuel transport plans approved by the chief of Maritime Technology and Safety Bureau and 161 transport containers that were approved by the Minister of Transport. (From the Nuclear Materials Transport Measures Office of the Nuclear Materials Regulation Division of the Nuclear Safety Bureau) (From the Nuclear Safety Studies Office of the Nuclear Safety Division of the Nuclear Safety Bureau)

### 3. Ensuring Safety in the Utilization of Radiation

#### (1) Authorization and Registration for Use of Radioisotopes

The use, sales, discarding, and any other handling of radioisotopes, the use of radiation-generating equipment, and the discarding and any other handling of matter contaminated by radioisotopes is regulated according to the "Prevention of Radiation Sickness Caused by Radioisotopes Act" (henceforth referred to as the "Radiation Sickness Prevention Act").

Table 1-12-1 indicates the state of licensing and other authorization in FY 1988 with respect to enterprises that use, sell, or discard radioisotopes.

**Table 1-12-1. State of Licensing and Other Authorization in FY 1988**

| | Use Enterprises | | Sales Enterprises (Licensed) | Disposal Enterprises (Licensed) |
|---|---|---|---|---|
| Type | Licensed | Registered | | |
| End of FY 1987 | 2,580 | 2,105 | 203 | 12 |
| End of FY 1988 | 2,586 | 2,142 | 206 | 12 |

#### (2) Spot Inspections at Radioisotope-Handling Enterprises

The director-general of the Science and Technology Agency, in conformance with the Radiation Sickness Prevention Act, can permit the administrator of radiation inspections to enforce spot inspections in enterprises that handle radioisotopes when the need to enforce the Radiation Sickness Prevention Act or laws based on it is recognized. During FY 1988, spot inspections were carried out at 404 business sites.

#### (3) Accidents at Business Sites where Radioisotopes are Handled

There were 2 accident cases involving radioisotopes during FY 1988 where small amounts of hermetically sealed radiation sources were lost. Regarding these accidents, on-site inspections were conducted and the necessary counter-measures were pointed out.

#### (4) Enforcing Radioisotope Safety Management Policies

In recent years, the use of radioisotopes is dramatically increasing. In order to work towards ensuring safety in the handling of radioisotopes, legislative revisions that were to go into effect on 1 April 1989 were made known to all concerned enterprises during FY 1988. In addition, in accordance with the Radiation Sickness Prevention Act, supervision and guidance, such as with rigorous investigations and spot inspections for licensing and authorization, was intensified, and classes on radiation safety management were held.

(From the Radiation Protection Division of the Nuclear Safety Bureau)

### 4. Promoting Safety Assurance Policies on Radioactive Waste Treatment and Disposal

#### (1) Current State of Radioactive Waste Treatment and Disposal

1) Radioisotope-Handling Enterprises

Liquid and gaseous low-level radioactive wastes produced by radioisotope-handling enterprises are processed as the need arises and, after certifying that they are well below the standard value set by law, they are released into the environment. Solid and partially-liquid radioactive wastes are temporarily stored in each enterprise's waste storage facilities and then are handed over to the Japan Isotope Association. The wastes are collected and brought to any one of the nation's 7 storage locations and are then finally transferred to the JAERI Tokai Research Laboratory. At JAERI, the wastes are safely deposited in warehouses after further processing.

2) Electricity-Generating Nuclear Power Plants

Liquid low-level radioactive wastes that are like laundry waste water and gaseous radioactive wastes are processed so that they are well below the standard value set by law and are then released into the environment. Regenerated waste fluids of ion exchange resins, mixed filter-sludge solids, and other liquid and solid radioactive wastes undergo treatment, such as cementation in metal drums, and are safely stored in warehouses within the facilities.

#### (2) Policy for Ensuring Safety in Radioactive Waste Disposal

Our country's basic policy on low-level radioactive waste disposal involves land and ocean disposal. Regarding land disposal, the plan to dispose wastes underground at Rokkasho Village in Aomori Prefecture is being promoted. The application for authorization to bury wastes underground was filed by the Japan Atomic Fuel Industry Co. in April 1988, and a safety investigation is underway.

As for the safety of low-level radioactive waste ocean disposal, the results of scientific investigations were brought forth in the report entitled "From a Scientific Perspective, We Cannot Think that the Effect of Ocean Disposal on Humanity and on the Marine Environment will Produce Insignificant Damage" at the ninth meeting of the London Treaty signatory countries in September 1985, and a resolution to temporarily halt marine disposal until scientific as well as government and social investigations are completed. These investigations are carried out by a panel of experts from the governments involved.

On the other hand, high-level radioactive wastes are solidified into a stable form and, after storing them for 30 to 50 years so that they cool, the basic policy is to dispose of them in deep geological strata. Consequently, in order to implement safety regulations for facilities storing high-level radioactive wastes that are generated as a result of overseas reprocessing consignments and are to be returned to our country, laws pertaining to waste storage enterprises were prepared and, on 27 March 1989, the Nuclear Safety Commission put together the report entitled "Regarding Points of View on Assessing the Safety of Waste Storage Facilities." This report becomes the guidelines for implementing safety investigations in waste storage enterprises.

(From the Radioactive Waste Regulations Office of the Nuclear Safety Division of the Nuclear Safety Bureau)

(From the Radiation Protection Division of the Nuclear Safety Bureau)

## 5. Promoting Environmental Safety Measures

### (1) Environmental Radioactivity Countermeasures

1) Monitoring Environments In and Around Nuclear Power Plants

Those who operate nuclear reactor facilities are obligated to keep a close watch on the radioactive substances discharged from nuclear power plants in the areas where the discharges originate and in areas within and around the facilities. Additionally, from the standpoint of guarding the health and safety of local residents, local community groups are maintaining surveillance outside of the nuclear power facilities' monitored areas.

Since FY 1974, grants-in-aid for local rural prefectures to monitor radiation have been provided through enterprises based on the Special Accounts for Promoting Development of Electric Power Resources (Electric Resource Special Account). Also in the Electric Resource Special Accounts, prefectures and groups of analytical experts have been conducting radioactivity analyses together since FY 1975, and comparative cross-checking of these results is helping to improve the accuracy of the analyses. In-service training to improve the nature of those in charge of the analysis efforts was also carried out during FY 1987. Furthermore, to assist in furthering the citizens' understanding of radioactivity levels in marine environments, radioactivity in marine environments has been comprehensively evaluated since FY 1983. These undertakings involve radioactivity studies on principal fishing grounds and other areas in and around nuclear power plants and investigative evaluations.

2) Activities of the Radioactivity Countermeasures Headquarters

In view of the gradual increase in radioactive fallout that accompanies nuclear explosion experiments, the Radioactivity Countermeasures Headquarters was set up within the Cabinet in 1961 to coordinate and interconnect organizations concerned with the problems of radioactivity countermeasures. In conformance with the policies of this office, cooperation amongst concerned ministries and agencies is obtained, and studies and research are carried out on the levels of environmental radioactivity that originated as radioactive fallout.

3) Environmental Radioactivity Studies

During FY 1988, the national test research institutions and urban and rural prefectural sanitation research laboratories continued efforts from the previous year to analytically measure environmental radioactivity in samples of food products and other substances from the environment.

Also, for the purpose of implementing appropriate radioactivity countermeasures, the national test research institutions carried out research on the behavior of radioactive nuclides in foodstuffs and in the environment.

4) Guidelines on Radioactivity Measurement Methods

Radioactivity studies by urban and rural prefectural sanitation research laboratories are currently based on guidelines established by the Nuclear Safety Commission for monitoring environmental radiation and on the analytical measurement manuals provided by the Science and Technology Agency.

Incidentally, the incorporation of the new International Committee on Radiation Protection recommendations (ICRP Pub.26) into domestic laws served as an impetus for revising the guidelines on environmental radiation monitoring in March 1989.

### (2) Investigative Research on Environments In and Around Nuclear Power Plants

The National Institute of Radiological Sciences carried out the "Study on Levels In and Around Nuclear Power Plants"; the Ministry of Health and Welfare, "Comparative Zoological Research on Concentrations of Marine Contaminant RI's in Living Organisms"; the Meterological Laboratory, "Investigative Research on Wide-Area Distributions of Radioactive Gases that Originate in Nuclear Power Plants"; and the Maritime Safety Agency, the "Studies on Marine Radioactivity Associated with Reprocessing Facility Operations."

### (3) Studies on Radioactivity Associated with US Nuclear Battleships' Port Calls

Studies are being carried out on radioactivity associated with port calls of American nuclear-powered battleships at Yokosuka Port, Sasebo Port, and the Kinbu Nakashiro Port in Okinawa Prefecture. During FY 1988, 29 American nuclear-powered battleships put in at Yokosuka Port, 5 at Sasebo Port, and 8 in Okinawa. These radioactivity studies are conducted in accordance with the Outline on Guidelines for Nuclear-Powered Battleship Radioactivity Studies and are divided into studies of periods when there are no port calls and periods when there are port calls.

(From the Disaster Prevention Environmental Measures Office of the Nuclear Safety Division of the Nuclear Safety Bureau)

### 6. Perfecting Nuclear Disaster Prevention Measures

Regarding electricity-generating nuclear power facilities, the Nuclear Reactor Regulation Law provides adequate safety measures for preventing the outbreak and escalation of accidents and for preventing disasters, and the law helps to ensure the health and safety of nearby residents. On the other hand, in the Basic Law on Disaster Measures, should an emergency situation arise where a large amount of radioactive substances are released, for instance, community groups in the vicinity are to follow local disaster prevention plans, which include nuclear disaster prevention plans, and nuclear plant personnel are to follow disaster prevention operations plans. The country's administrative organizations, too, are to follow their respective disaster prevention operations plans and are to work in close cooperation with local community groups, providing instruction, advice, and dispatching specialists to the site of the accident.

From the standpoint of augmenting this kind of disaster prevention system and, given the impetus of the accident at America's Three Mile Island nuclear power plant, perfecting and maintaining disaster prevention measures for electricity-generating nuclear power facilities, the Central Disaster Prevention Council agreed upon the "Immediate Measures Which Should be Taken in Nuclear Power Plant Disaster Prevention" on 12 July 1979.

The "Emergency Technical Advisory Organization," established by the Nuclear Safety Commission on 28 June 1979, is incorporated into these "Immediate Measures Which Should be Taken." The measures prepared for services to dispatch specialists to accident sites during an emergency and maintenance of a technical advisory system for the country.

On 30 June 1980, the Nuclear Safety Commission decided upon the report entitled "About Disaster Prevention Measures in and around Nuclear Power Plants," which is about the specialized items needed in striving for more harmonious implementation of disaster prevention activities in and around nuclear power plants, and presented the report to the Prime Minister. The chief of the Central Disaster Prevention Council notified all organizations and local community groups concerned with nuclear power plant disaster prevention of this decision. The ideas of this decision are being given adequate attention, and perfecting and maintaining disaster prevention measures is being worked towards.

The Science and Technology Agency also accepted these measures and, after revising its disaster prevention operations plan in October 1980, reinforced the national support system for nuclear power disasters.

Furthermore, first the Science and Technology Agency and then other related organizations have been collaborating in the publication of a variety of emergency manuals, such as manuals for local disaster prevention programs. Regional community groups have been modifying their local disaster prevention programs to conform with the guidance and advice provided by the manuals and the government.

On a national scale, on the other hand, a grants-in-aid system in the Special Accounts for Promoting Development of Electric Power Resources has been in place since FY 1980 as a budgetary measure for promoting the maintenance and perfection of disaster prevention measures. It provides grants to rural prefectures for operating fees needed for emergency communication nets, emergency monitoring systems, maintenance of emergency medical treatment and other systems, the education and training of personnel involved in disaster prevention operations, and maintenance of disaster prevention data, equipment, and materials.

Also, building the System for Prediction of Environmental Emergency Dose Information (SPEEDI) network has been progressing since FY 1985. The purpose of this system is to swiftly calculate and predict the spread of radioactive substances discharged in the atmosphere and the ensuing radiation exposure doses. Because of the efforts involved in perfecting and strengthening SPEEDI and also an emergency medical treatment system maintained by the National Institute of Radiological Sciences, national and regional services for disaster prevention measures are progressing.

Additionally, in May 1987 the Nuclear Safety Commission put together a report of its investigative studies on the emergency measures adopted by the Soviet Union to cope with the nuclear power plant accident that occurred there in April 1987. The report concluded that there was no discernible need to fundamentally modify any disaster prevention measures and systems that were developed with due consideration of the unique characteristics of our country's nuclear power facilities. The report indicates that henceforth, given the impetus of the Soviet accident, it is important to round out the contents of all disaster prevention measures and to make those measures more effective. This laid the groundwork for investigative deliberations on plans to perfect disaster prevention measures by the Nuclear Safety Commission's Specialists Group on Disaster Prevention Measures In and Around Nuclear Power Plants.

(From the Disaster Provention Environmental Measures Office of the Nuclear Safety Division of the Nuclear Safety Bureau)

## Chapter 13. Promoting Space Development

### 1. Space-Development-Related Activities

While giving due consideration to the state of affairs in all other countries, our country actively promotes space development, an area of important significance as a field which both helps to improve the quality of the people's lifestyles and also brings a new realm of activities to mankind. During FY 1988, we focused mainly on the following kinds of space development activities.

**1) Space Activities Commission**

During FY 1988, the Space Activities Commission estimated costs for FY 1989 space-development-related operations and agreed upon a space development program on 15 March 1989. The Space Activities Commission also conducted safety reviews on artificial satellite launches and the launches of satellite-launching rockets, evaluated the results of satellite launches from rockets, and conducted investigative reviews for the purpose of revising the space development policy outline.

The Space Activities Commission also held a forum on matters related to space development in March 1989 and invited Mr. Chonpontai, the president of the National Research Council, to attend.

(From the Space Activities Planning Commission of the Research and Development Bureau)

**2) Science and Technology Agency**

The Science and Technology Agency is currently engaged in the following activities: planning, drafting, and pushing through basic policies on space development; regulating policies on estimating operational and other costs related to space development S&T in test research institutions; promoting international cooperation; overseeing the affairs of the National Space Development Agency (NASDA); and promoting the utilization of outer space.

In the international arena, the Science and Technology Agency has participated in the UN Committee for the Peaceful Utilization of Outer Space and the committee's Science and Technology Subcommittee and Legal Subcommittee, and has promoted activities such as joint research with the US.

In addition, to work towards problemless rocket-launch experiments, the agency has made progress in negotiations with people involved in fishing industries near Tanegashima, has helped further fishing industry policies, and has regulated the timing and number of rocket launches. (From the Space Activities Planning Commission of the Research and Development Bureau)

**3) National Space Development Agency**

In accordance with the "Basic Space Development Program" that was established by the Prime Minister, NASDA launched the "Sakura 3-B" communications satellite from the No 2 (3-stage) H-I rocket in September 1988; continued development of the No 4 geostationary meteorological satellite, the No 3 broadcast satellite, the No 1 earth resources satellite, and a type-VI engineering test satellite; commenced the development of the No 1-b ocean observation satellite and the No 5 geostationary meteorological satellite; and started R&D work on an earth observation platform satellite.

Furthermore, NASDA pushed forward with development of the first material experimentation system and continued its participation in internationally collaborative efforts on the space station program.

Regarding rockets, NASDA continued progress in the development of the H-I rocket, which is capable of launching a 550-kg geostationary satellite, and the H-II rocket, which is capable of launching a two-ton-class geostationary satellite.

In addition to these activities, NASDA also maintains the facilities at the Tanegashima Space Center and the Tsukuba Space Center.

(From the Space Development Division of the Research and Development Bureau)

**4) National Aerospace Laboratory**

The National Aerospace Laboratory is making progress in fundamental and pioneering research, the objectives of which are to establish independent technology. During FY 1988, the National Aerospace Laboratory conducted research on innovative aerospace transport technology, liquid hydrogen/liquid oxygen rocket engine components, basic satellite technology, and experimental technology for utilizing the environment of outer space. In addition, it collaborated with NASDA in 16 joint research projects, one of which was "High-Pressure Liquid Oxygen/Liquid Nitrogen Rocket Engine Research."

(From the Space Activities Planning Commission of the Research and Development Bureau)

**2. Space Development Policy Outline and Space Development Program**

Along the basic guidelines set forth in the Space Development Policy Outline, our country's space development is promoted in accordance with yearly space development programs devised by the Space Activities Commission.

Because of the need to systematically promote space development under the authority of a long-term policy, the Space Activities Commission formulated the Space Development Policy Outline in March 1978 as the basic framework and guidelines for our country's space development.

The Space Activities Commission revised the policy outline in February 1984 after taking into account current international and domestic trends in opinions on space development.

(Basic space development guidelines indicated in the outline)

1) Peaceful utilization, coping with social needs, and harmonization with national resources
2) Ensuring independence
3) Promoting international cooperation

A long-term policy group set up by the Space Activities Commission undertook the task of making further revisions to the Space Development Policy Outline in 1987.

Basing its decisions on the spirit of the policy outline, the changes in social attitudes, and international and domestic

technological trends, the Space Activities Commission then made the necessary changes and additions to the results of the program revisions from 1 March 1988 and, on 15 March 1989, agreed upon the "Space Development Program." For scientific fields, this program entails the development of the No 13 scientific satellite (MUSES-A), the No 14 scientific satellite (SOLAR-A), the No 15 scientific satellite (ASTRO-D), and the No 16 scientific satellite (MUSES-B); the target launch dates for these satellites, which are to be launched from an M-3 S-II rocket, are in FY 1989, FY 1991, FY 1992, and FY 1993, respectively. Also, progress is being made in the continuing development of the magnetosphere observation satellite (GEOTAIL), with a target launch date in FY 1992, and in the preparations for the space science experiments using a particle acclerator (SEPAC), the goal of which is to conduct repeat-experiments using the space shuttle, which is scheduled for launch in FY 1990.

As for practical-use fields, progress is being made in the development of the following satellites, which are to be launched from an H-I rocket: the No 4 geostationary weather satellite (GMS-4) and the No 1-b marine observation satellite, with target launch dates in FY 1989; the No 3 broadcast satellites (BS-3a and BS-3b), in FY 1990 and 1991; and the No 1 earth resources satellite (ERS-1), in FY 1991. The No 5 geostationary meteorological satellite (GMS-5), which is to be launched from an H-II rocket, is also being developed, with a target launch date in FY 1993.

In addition, with an approximate launch-date in FY 1994, developmental research on the earth observation platform engineering satellite (ADEOS), which is to be launched from an H-II rocket, is progressing.

Furthermore, a type-VI engineering test satellite (ETS-VI) is being developed, with a target launch date in 1992. The objectives for this satellite include validating the performance of H-II rocket test equipment and establishing the large-type geostationary three-axis satellite bus technology that is needed for practical-use satellite development in the 1990's. Aiming for implemention of first material tests (FMPT) in FY 1991, an experimental system is also being developed; scientists and technicians that will be on-board [the space shuttle] are undergoing training and other preparations; and on-board test equipment is being developed for carrying out material tests during participation in America's First International Microgravity Laboratory (IML-1), which will be implemented in FY 1990. As for the space station program that is being promoted through international cooperation, FY 1996 is the target for completion of the space-station-attachment-type experimental module (JEM) and other equipment that will be launched from the space shuttle. Also, the space experiment and observation free-flyer (SFU), which will be launched from an H-II rocket, is being developed, with a target launch date in FY 1992.

Regarding rockets that are used to launch artificial satellites, M-rocket development is continuing and progressing. As for the H-II rocket, which, in order to cope with the demand for launching large satellites in the 1990's, has the capacity to launch 2-ton geostationary satellites, continuing development is progressing with the goal of launching the No 1 test machinery in FY 1991.

(From the Space Activities Planning Commission of the Research and Development Bureau)

### 3. Space-Related Budgets

Our country's space-related budgets are shown in Table 1-13-1.

**Table 1-13-1. FY 1988 Changes in Space-Related Budgets for each Agency (Initial Budgets) Amount of National Treasury debt liability limit (Unit: ¥ 1000)**

| Ministry or Agency | FY 1988 | FY 1989 |
|---|---|---|
| Science and Technology Agency | 102,604,160* | 84,411,748* |
| | 98,469,996 | 109,062,081 |
| National Police Agency | 381,583 | 107,906 |
| Environmental Agency | | 51,450 |
| Ministry of Education, Science and Culture | 10,491,400* | 11,323,480* |
| | 19,790,488 | 20,785,120 |
| MITI | 9,000,745* | 14,562,501 |
| | 14,088,975 | |
| Ministry of Transport | 1,709,166 | 1,213,027 |
| | 5,731,085 | 6,274,422 |
| Ministry of Posts and Telecommunications | 918,900* | 44,290* |
| | 3,198,688 | 4,018,876 |
| Ministry of Construction | 2,028 | 2,076* |
| Ministry of Home Affairs | 118,611 | 119,715 |
| Total | 124,724,371* | 96,992,545* |
| | 141,781,454 | 154,994,147 |

(From the Space Activities Planning Commission of the Research and Development Bureau)

### 4. The Signing of Three Space-Related Treaties

The treaty that lays down the basic international principles on the development and utilization of space is entitled "The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies" (the Treaty on Outer Space). Our country signed this treaty at the same time that it came into effect in 1967, but we did not sign three other space-related treaties when they later came into effect. These three treaties are: "The Agreement on the Rescue and Return of Astronauts and the Return of Objects Launched into Outer Space" (the Rescue and Return Agreement), "The Treaty on International Responsibility for Damages Incurred by Objects in Outer Space" (the Damage Compensation Treaty), and "The Treaty on Registration of Objects Launched into Outer Space" (the Registration Treaty). We did not sign these treaties because the possibility of their applicable situations occurring is small. However, the problems with the falling of a Soviet nuclear-powered satellite in both January 1978 and January 1983 served as a turning point; from the standpoints of coping with such problems involving falling objects from outer space and of positively contributing to international cooperation in space activities, the tendency towards signing the three treaties intensified. Consequently, coordination amongst related agencies and ministries moved forward, and, during the 98th session of the the Diet (an ordinary session), after approval was obtained and respective procedures were followed for each treaty, we became a signatory country for each of the three treaties.

(From the International Space Affairs Division of the Research and Development Bureau)

### 5. Survey of Trends in Space Science and Technology

A survey was conducted on the state of other countries' space development programs and their implementations.

In the US, after the space shuttle "Challenger" accident in January 1986, a presidential accident investigation committee reported on the cause of the accident in June of that year, requested modifications to the design of the rocket motor, and recommended a reorganization of NASA's internal structure. Afterwards, space shuttle launches that resumed in September 1988, with the Discovery (STS-26) as the first launch, have been successful.

In Europe, the European Space Association (ESA) has become the center of various activities. The ESA governing counsel that met in November 1987 approved a new, long-term space program (1988-2000) under which, starting in January 1988, the following developments are commencing: 1) the "Ariane 5" improved-launch-capacity rocket, 2) the "Hermes" European space shuttle, and 3) the "Columbus" European space station project.

Also, following the launch failure of Europe's independently developed V18 Ariane-rocket in May 1986, rocket launches were suspended and smooth progress was made in detecting the cause of the problems and improving the defective areas. In September 1987, launches resumed with the V19 rocket and have since been successful.

The Soviet Union is steadily working towards long-term manned space activities and space experimentation using the "Mir" space station. In December 1988, the record for the longest stay in space was established by the astronaut Vladimir Chetov (366 days).

In addition, China is also conducting activities using its independently developed Long March rocket, and Canada, India, Australia, and other countries are developing and employing communications and other types of satellites.

## Chapter 14. Promoting Ocean Development

### 1. Comprehensive Promotion

#### 1) Comprehensive Promotion of Ocean Development

As an organization involved in the comprehensive promotion of ocean development in our country, the Ocean Development Council (an advisory body within the Prime Minister's office) investigates and deliberates basic and general matters related to ocean development and reviews all ocean development issues.

#### 2) Comprehensive Promotion of Marine S&T Development

In order to intensely promote ocean development, the comprehensive and systematic promotion of marine science and technology is extremely important. Every year, the Liaison Council of Ocean Development-Related Ministries and Agencies, which is made up of the heads of concerned ministries and agencies, formulates the "Ocean Development Promotion Program" as the the nation's overall ocean development program.

### 2. Government Budgets for Marine S&T-Related Costs

**Table 1-14-1. Government Budgets for Marine S&T-Related Costs (Unit: ¥ 1 million)**

| Ministry or Agency | FY 1986 | FY 1987 | FY 1988 | FY 1989(Note 1) |
|---|---|---|---|---|
| Science and Technology Agency | 14,110 | 10,681 | 11,536 | 18,925 |
| Environmental Agency | 701 | 608 | 676 | 696 |

Table 1-14-1. Government Budgets for Marine S&T-Related Costs
(Unit: ¥ 1 million) (Continued)

| Ministry or Agency | FY 1986 | FY 1987 | FY 1988 | FY 1989(Note 1) |
|---|---|---|---|---|
| National Land Agency | 291 | 385 | 372 | 40 |
| Ministry of Education, Science and Culture | 1,295 | 1,202 | 1,059 | 405 |
| Ministry of Agriculture, Forestry and Fisheries | 9,581 | 9,523 | 9,543 | 10,601 |
| MITI | 13,199 | 13,015 | 14,173 | 8,311 |
| Ministry of Transport | 11,129 | 8,464 | 9,067 | 6,646 |
| Ministry of Posts and Telecommunications | 325 | 393 | 124 | 112 |
| Ministry of Construction | 469 | 520 | 387 | 453 |
| Defense Agency (Note 2) | 571 | 554 | 693 | 852 |
| Total | 51,100 | 44,791 | 47,137 | 46,189 |

(Note 1) Costs decided upon during the implementation stage are excluded from the FY 1989 budget figures.
(Note 2) Although the Defense Agenecy is not a member of the Liaison Council of Ocean Development-Related Ministries and Agencies, it was added for reference.

### 3. Marine S&T-Related Research with the Coordination Funds for Promoting Science and Technology

During FY 1988, the following four research subjects were implemented as marine S&T-related areas supported with the Coordination Funds for Promoting Science and Technology.

(1) Research related to the development of technology with which to effectively utilize deep-sea resources
(2) Research on elucidation of the ocean plate formation region in the South Pacific Ocean (the rift system)
(3) International joint research on the atmospheric and ocean fluctuations in the Pacific Ocean and climatic fluctuations
(4) Research on earthquake tectonics in the active structural regions of central Japan

### 4. Promoting Investigative Research on Ocean Development

The following projects of the Science and Technology Agency's investigative research on ocean development are implemented primarily by the Japan Marine Science and Technology Center and, when the need arises, with the cooperation of related ministries and agencies.

#### (1) Deep-Sea Survey Submersible R&D

Since July 1983, the Japan Marine Science and Technology Center has been using the "Shinkai 2000" survey submersible for deep-sea investigative research.

During FY 1988, thermal vent phenomena were discovered in ocean-type seamounts in the Ogasawara Islands, and the discoveries of thermal vents and numerous hot-water-gushing chimneys in the Okinawa Trough added important knowledge to research on crustal activities and the formation of hydrothermal deposits. In addition, the "Dolphin 3K" unmanned probe has been employed, and construction of a 6,000-meter-class survey submersible and a support mother ship has progressed. Of these, the mother ship, named "Yokosuka," was launched on 25 July 1988, and the survey submersible, named "Shinkai 6500," was put to sea on 19 January 1989. Furthermore, basic design for a 10,000-meter-class survey submersible was conducted.

#### (2) Diving Operations Technology R&D

To develop safe and efficient diving technology, the Science and Technology Agency has been engaged in the development of undersea diving operations systems that are based on the principles of saturation diving. These systems have been used since FY 1968 as the basic technology for developing and utilizing the continental shelf. The Science and Technology Agency also implemented the "New Seatopia Program," in which actual underwater experiments are carried out in depths of up to 300 meters with the "Kaiyo" undersea operations experimental vessel. The first success in an actual diving experiment conducted 300 meters beneath the sea was achieved in July 1988.

#### (3) Investigative Research on the Development and Utilization of the Black Current

The Black Current region is becoming an excellent fishing area that is high in biological productivity; it also holds a vast amount of kinetic energy and thermal energy. Because of the needs to systematically gather various kinds of data on the Black Current region, evaluate its possibilities, and as quickly as possible put together development and utilization policies for the region, concerned organizations have been consolidating their resources since FY 1977 and conducting studies, to get a grasp on the actual conditions of the Black Current (its energy and capacity for purification, the mechanisms of its fluctuations, and its basic biological production mechanisms), and assessments of the Black Current's marine characteristics and potential.

Joint efforts with China in the aforementioned investigative research continued into FY 1988. Fifteen Japanese researchers and 17 Chinese researchers took part in an exchange which also involved mutual visits by all seven of Japan's survey ships and two Chinese survey ships.

**(4) Marine Observation Technology R&D**

For elucidation and measurement of marine fluctuation phenomena, which are closely connected with atmospheric fluctuation phenomena and variations in fishing and marine conditions, it is important to develop three-dimensional marine observation technology and wide-area observation technology and to find ways to establish marine observation technology in which the former are integrated. To that end, the Japan Marine Science and Technology Center has been developing a variety of observation equipment and has been conducting research on survey methods. During FY 1988, the center's activities involved sailing-type observation system R&D, investigative research on marine lasers, microwave sensor R&D, research on systematizing marine observation equipment, and unmanned observation technology R&D on Okinodori Island.

**(5) Ocean Utilization Technology R&D**

As common and basic technology R&D that is required for comprehensively developing and utilizing the ocean's space, energy, living organisms, minerals, and other resources, R&D efforts in sea-area control technology and energy utilization technology are being carried out.

During FY 1988, sea-area control technology R&D involved wave-concentration-and-cancellation technology in open sea areas, and technology for building artificial coral reefs by electrodeposition. Energy utilization technology R&D involved investigating design methods for an optimal wave-powered electric generating system, using data that has been obtained thus far from actual sea-trials of the "Kaimei" wave-powered electric generating system.

**(6) Research on Marine Remote Sensing Technology Development**

Because simultaneous and repetitive observations over wide areas are possible with remote sensing technology, its practical application as a new method for observation and surveying is expected to supplement or replace existing marine survey ships and observational buoys.

To that end, a five-year program to conduct comprehensive developmental research on marine remote sensing was carried out from FY 1977 through FY 1981 for the purpose of establishing the technology that will enable the employment of remote sensing in marine surveying. The second phase, since FY 1982, of comprehensive developmental research on marine remote sensing involves the following research areas: optimal wavelengths in the visible, infrared, and microwave regions of the spectrum; using microwave sensor data obtained at ocean-surface levels in the measurement of ocean phenomena; using visible and infrared sensor data for getting a grasp on marine biological resources, for studying the marine dynamics that cause fluctuations in marine conditions, and for coastal disaster prevention; data acquisition systems. Since FY 1985, research involving measurement of marine phenomena using microwave sensor data obtained from aircraft levels has commenced.

**(7) Regional Joint R&D**

The evolution of regional R&D enterprises is essential to the advancement of ocean development. In recognition of this fact, when selecting subjects for implementation, due consideration is given to the importance and newness of technology subjects brought forward by local governments in connection with the concept of ocean utilization. Regional cooperation in R&D projects started in FY 1988, with actual sea-trials in the marine areas of urban and rural prefectures wishing to become involved. During FY 1988, the "Actual Sea Demonstration Trials of Marine Biological Behavioral Control Technology" was begun in Kumamoto Prefecture, and the "Coral Reef Building Technology R&D" effort commenced in in Okinawa Prefecture.

(From the Ocean Development Division of the Research and Development Bureau)

## Chapter 15. Promoting the Life Sciences

**1. About the Life Sciences**

The life sciences cover a broad spectrum of viewpoints on the phenomenon of life that is made manifest by a variety of living organisms, ranging from the fundamental to the comprehensive. The objectives of the life sciences are to elucidate the complex and precise mechanisms seen in living phenomena, such as the regulatory mechanisms characteristic of living organisms, heredity, energy conversion, and self-protection function, and to use this knowledge in solving the problems associated with human life. Results of life science research are expected to enable the development of completely new technology in many fields such as health and medicine, environmental conservation, agricultural production, and industrial production.

**2. Trends in the Council for Science and Technology**

The Council for Science and Technology (CST) has been pointing out the importance of the life sciences for many years. In July 1973, it created the Life Sciences Division for the purpose of deliberating promotional policies for the life sciences. Contents of the division's discussions were compiled in an interim report in December 1974.

In August 1980, the Life Sciences Division submitted to the Prime Minister a report entitled "Opinions on Promoting the Life Sciences," which indicated 32 subjects in 9 fields as important research objectives in the life sciences, and, as a policy for achieving those goals,

pointed out the need for strengthening the life sciences promotion system, rounding-out research support, ensuring and cultivating research talent, and promoting international cooperation. In addition, the CST conducted deliberations on the Prime Minister's tenth inquiry, dated November 1981, which was entitled "On the Basic Research and Development Program for Promoting Fundamental and Pioneering Technology in the Life Sciences," and reported its findings in July 1974. In August of the same year, the Prime Minister set forth a basic program policy that was based on the council's advisory report.

The importance of the life sciences was also pointed out in the CST advisory report in reply to Inquiry No 11 (November 1974) and in the Science and Technology Policy Outline (a 1986 Cabinet decision), as well as in the following reports: "Opinions on Basic Policies for Cancer Research" (July 1983), "Opinions on Basic Policies for Science and Technology Promotion in Coping with an Aged Society" (May 1986), "Opinions on Basic Policies for Promotiong Research and Development in Neurological Science and Technology" (August 1987), "Opinions on Basic Policies for Promotiong Research and Development in Immunology" (August 1988).

As for recombinant DNA research, the Life Sciences Division is giving priority to deliberations on promotional policies for this field.

Regarding analytical research in human genetics, which has been recently gaining considerable attention internationally as well, in June 1988 the Council for Aeronautics, Electronics and Other Advanced Technologies indicated policies for R&D promotion of this field in an advisory report it submitted in reply to Inquiry No 12, "On the Promotion of Comprehensive Research and Development in Human Genetics Analysis."

### 3. The Science and Technology Agency's Policies for Promoting the Life Sciences

The Science and Technology Agency coordinates guidelines on estimating life sciences-related costs for concerned ministries and agencies. By applying the Coordination Funds for Promoting Science and Technology, the agency also actively promotes research projects in fundamental and pioneering fields, gaining the participation of the national test research institutions, universities, and the private sector in the planning of projects such as "Research on the Development of Technology for Analyzing and Controlling the Biological Information Transfer Mechanism," "Research on the Development of Basic Technology for Elucidating Brain Functions," and "Research on the Development of Developmental Engineering Technology."

The main results of research projects thus far include establishing technology for producing a hepatitis-B vaccine using recombinant DNA technology and the development of a system for analyzing DNA base sequences. The agency is striving to elevate the standard of our country's life science research by holding symposiums that focus on these research results.

The Science and Technology Agency is currently implementing research at RIKEN for the Life Sciences Project; bio-homeostasis research, which is a part of the International Frontier Research System; and research on thought functions. It is also involved in carrying out support for the Microbiological Strains Preservation Project, which will play an important role in the life sciences; the Gene Bank Enterprise, which gathers, preserves, and provides the necessary cells and genes for research; and the development of experimental animals. At the Research Development Corporation of Japan, the agency is implementing research on plant information substances and developmental genes, and is commissioning development work, for the purpose of commercialization, on new life sciences-related technology. The agency is also promoting research in the life sciences at the National Institute of Radiological Sciences and at the Japan Atomic Energy Research Institute.

Furthermore, as international cooperation in the life sciences, the Science and Technology Agency is carrying out joint research within various different frameworks.

With the US, it is collaborating in research on recombinant DNA, for example, based on the Japan-US Scientific and Technical Research and Development Cooperation Agreement. With West Germany, cooperation is being promoted under the auspices of the Japan-Germany Panel on Biology and Medicine, based on the Japan-Germany Scientific and Technological Cooperation Agreement.

The Science and Technology Agency's cooperation with China, as well, involves exchanging information and other activities in fields such as the development of experimental animals, in accordance with the Japan-China Scientific and Technical Cooperation Agreement.

### 4. Promoting Recombinant DNA Research

Recombinant DNA research is, by all means, the basic biological research that sheds light on the structure of genes in living organisms and on how those genes work. But it is also a new field within the life sciences that has been especially gaining attention recently as an area which contributes tremendously, in a wide range of fields, to the welfare of humanity. These fields include elucidation of the causes of cancer and other diseases; mass production of insulin, interferon, and other scarce pharmaceuticals; and research applications in the breeding of useful microorganisms and crop-breeding.

For these reasons, the Prime Minister formulated the "Guidelines on Recombinant DNA Experimentation" in August 1979, in response to the advisory report he received in reply to Inquiry No 8, "On the Policies for Promoting Genetic Recombination Research." These guidelines are aimed at rational promotion of research in

the field of recombinant DNA. Afterwards, eight revisions were carried out and "Thoughts on Experimentation using Plants" was set forth in December 1988. Furthermore, ongoing efforts to promote recombinant DNA research include employing the Coordination Funds for Promoting Science and Technology to implement comprehensive research projects.

### 5. Promoting Cancer Research

Cancer is the largest cause of death in our country, accounting for about a quarter of all deaths; cancer-control policy is an urgent subject that we must tackle with all of our resources.

Regarding the elucidation of cancer's instincts, shedding light on the construction and separation of cancer genes and other such elucidation at the molecular and genetic levels has been steadily progressing.

Advances in technology for diagnosing and treating cancer are making it possible to detect several different types of cancer in its early stages. Employing surgery, chemical therapy, radiation therapy, and other therapeutic methods is enabling a certain degree of cancer control. From now on, increased efforts to promote cancer research are expected to bring about a number of breakthroughs in cancer control.

In view of this situation, the "Comprehensive Ten-Year Strategy for Cancer Control" was adopted in June 1983 at a meeting of the Ministerial Council on Cancer Control, the objective of which was elucidation of the cancer instinct, and it was decided that related ministries and agencies would advance policies for promoting concrete cancer-control measures. After receiving the CST report entitled "Opinions on Basic Policies for Promoting Cancer Research" (July 1983), the Science and Technology Agency has been promoting "Research on the Development of Common, Basic Technology to Support Cancer Research" with the Coordination Funds for Promoting Science and Technology. The agency is promoting research on the application of heavy-particle (baryon) beams in cancer treatment at the National Institute of Radiological Sciences, and research on the analysis of cancer genes at RIKEN. Related ministries and agencies are also promoting extensive R&D in areas such as elucidation of cancer instincts at the molecular level and the application of those results in the prevention, diagnosis, and treatment of cancer; and research on the application of pioneering technology in the prevention, diagnosis, and treatment of cancer.

(From the Life Sciences Division of the Research and Development Bureau)

## Chapter 16. Promoting Substance/ Materials-Related Science and Technology

### 1. Substance/Materials-Related Science and Technology

Substance/materials-related science and technology not only contributes to socioeconomic development but is also the common, basic technology that supports a broad range of scientific and technological fields. Starting with atomic energy development, spcae activities, and ocean development, it goes hand in hand with advances in leading-edge technological developments such as electronics technology and technology associated with new and existing energies. Expectations for materials performance are approaching heretofore unimaginable, rigorously-high degrees. Materials development, which copes with such sophistication in social needs, and the creation of substances and materials with innovative functions are important subjects that will affect socioeconomic as well as scientific and technological evolution in the future.

### 2. Trends in the Council for Science and Technology

The importance of promoting substance/ materials-related S&T as one of the fundamental and pioneering areas of science and technology is pointed out in the eleventh CST advisory report (November 1984) and in the Outline on Science and Technology Policy (a Cabinet decision from March 1986). Among those areas of S&T that will serve to activate the economy, the CST report proposes promoting the development of new raw materials. Furthermore, based on these recommendations, the CST set up the Substance/Materials-Related Science and Technology Division upon receiving Inquiry No 11, "On the Basic Research and Development Program for Substance/Materials-Related Science and Technology," and examined promotional policies and R&D objectives for this field. An advisory report with the same title was submitted in August 1987 and was then officially adopted by the Prime Minister on 22 October 1987.

In addition, discoveries of new superconducting oxide materials since 1986 have given momentum to rapidly and increasingly mounting expectations for practical applications in superconductors. In November 1987, a report entitled "On Policies for Basic Promotion of Superconductor Research and Development" was put together at the CST Policy Committee's round-table discussions on superconductors.

In its fifth and seventh advisory reports (August 1980 and September 1984, respectively), the Council for Aeronautics, Electronics and Other Advanced Technologies makes recommendations on models for promotional policies associated with the aforementioned substance/ materials-related S&T and with limit S&T, the technology used in super-high-pressure and ultralow-temperature applications, and proposes comprehensive promotional policies on new materials creation. Also, in its ninth advisory report (March 1986), the council proposed comprehensive promotional policies on control technology, such as beam and limit technologies, and on instrumentation technology, which provides the important foundation for advancements in materials development. In addition, the council is currently carrying out studies in response to Inquiry No 13, "On

Comprehensive Promotion of Research and Development of New Substances and Materials which Exhibit Functions and Respond Intelligently to Environmental Conditions," the objective of which is the creation of new substances and materials, based on the new concept of intelligent materials, with innovative functions.

### 3. Promotion of Substance/Materials-Related Science and Technology within the Science and Technology Agency

Along the lines of the aforementioned advisory reports, the Science and Technology Agency is comprehensively promoting research in substance/materials-related S&T at the National Research Institute for Metals, the National Institute for Research in Inorganic Materials, and other national test research institutions. The main gist of that research is explained below.

1) Heat-Resistant and Low-Temperature-Resistant Materials

As research on materials that are resistant to high temperatures, the National Research Institute for Metals conducted "Basic Research on Material Design Methods for Supporting Innovative Materials Development" (special research).

As research on materials that are to be used for their resistance to low temperatures, the National Research Institute for Metals carried out R&D work on high-performance, ultralow-temperature-use structural materials, which are necessary in equipment that utilizes superconductivity.

2) High-Performance Structural Materials

Research on improving metal degradation caused by neutron-beam irradiation and on low-temperature brittleness evaluations of metals used in nuclear fuel transport containers was conducted at the National Research Institute for Metals.

Research and development at the National Institute for Research in Inorganic Materials involved work on diamonds and cubic nitriding boron for super-friction-resistant structural materials and work on synthetic apatite as a biomaterial.

3) Special Functional Materials

The National Research Institute for Metals conducted research on high-performance superconducting wiring materials, high-performance light-emitting elements, metallic magnetic fluids, and the development of technology for manufacturing ultrafine powders.

The National Institute for Research in Inorganic Materials, conducted research on fabricating semiconductors from diamonds, biofunctional ceramics, and new inorganic scintillator substances.

4) New Production and Processing Technology

The National Research Institute for Metals conducted chemical-reaction-engineering research on consecutive reaction processes and research on the creation of intermetallic composite materials using self-combustion methods.

The National Institute for Research in Inorganic Materials conducted research on super high pressure technology, which is indispensable in research on creating inorganic materials.

In addition to these, starting with industrial, university, and government research organizations, the Coordination Funds for Promoting Science and Technology are used in the promotion of the following: "Research on Technology for Analyzing and Evaluating High-Performance Functional Materials using New Beam Technology," "Research on Basic Technology for New Materials Creation Based on Hybrid Structure Design Technology," "Research on the Development of Technology for Generation, Measurement, and Utilization of Super-High Temperatures," "Research on Basic Technology for Imparting New Functional Capabilities to Rare Metals Through High-Level Purification," and "Research on Basic Technology for Development of Gradient Functional Materials for Thermal Stress Relaxation."

Also, "Research on the Development of Technology for Ultra-High Vacuum Generation, Measurement, and Utilization" and "Research on the Development of Technology for Generation and Utilization of Vacuum Ultraviolet Light" commenced in FY 1988.

The "Study on the Construction of a Database for Superconductor Materials Research" was implemented as a substance/materials-related investigation.

The Research Development Corporation of Japan, as a creative S&T promotion enterprise, conducted exploratory research to search for seeds in the area of materials, basing its efforts on three themes, one of which was chemical composition. The enterprise was also commissioned to develop new technology for manufacturing fine powders for use in non-oxide ceramics and new technology for manufacturing white electrically-conductive materials for use in composite materials.

Through the International Frontier Research System, RIKEN conducted research on frontier materials (quantum devices, molecular devices, and biodevices).

5) New Superconducting Oxide Materials

(Multi-Core Project on Superconductor Research)

Since 1986, new superconducting-oxide substances that exhibit superconductivity at high temperatures have been discovered one after another. In our country, too, bismuth-based superconducting oxide substances were discovered in January 1987 (National Research Institute for Metals: 105K critical temperature). If practical applications can be found for these new superconducting

substances, the socioeconomic impact will be tremendous; internationally as well, great expectations are mounting. However, these achievements are still at the substance stage, and ongoing basic R&D efforts for turning the substances into materials are important. Consequently, the Science and Technology Agency launched the "Multi-Core Project on Superconductor Research" during FY 1988, based on a round-table discussion entitled "On Basic Promotional Policies for Superconductor Research and Development" by the CST Superconductor Policy Committee. Organizations with R&D potential—the National Research Institute for Metals, the National Institute for Research in Inorganic Materials, RIKEN, JAERI, and special public corporations—are at the core of this project, which promotes flexible joint research, researcher exchange, and information exchange amongst the main body of researchers at home and abroad. The project involved efforts such as the development of a variety of super-ferromagnetic-field magnets and a super-high-resolution electron microscope, and research on making thin films from new superconducting-oxide substances.

(From the Materials Development Promotion Office of the Interministerial Research and Development Division of the Research and Development Bureau)

## Chapter 17. Promoting Aeronautical Engineering Research and Development

### 1. Research on the Fan-Jet STOL Aircraft

The fan-jet STOL aircraft is capable of take-offs and landings on short runways; moreover, it is a new, low-noise type of aircraft. Well suited to conditions in our country, this aircraft can accommodate the increased domestic demand for aircraft and can alleviate problems with airport land shortages and noise pollution. Its activity in private air transportation of the future is anticipated.

The Science and Technology Agency carried out "Comprehensive Research on the STOL Transport System" from FY 1972 to FY 1974 and clarified the basic concept of the STOL transport system as the most suitable type of aircraft for our country. In December 1975, the Council for Aeronautics Technology brought forth the proposal entitled "On Concrete Measures for Promoting Development of a STOL Aircraft Transport Suitable for Our Country," pointing out the research subjects required in the development of the STOL transport system and advocating the commencement of comprehensive R&D work on STOL technology, including the development of experimental aircraft and flight experiments. Starting in FY 1977, the Aerospace Technology Research Institute, which had been making great strides in basic research on existing STOL technology, undertook serious R&D work. This R&D program encompassed research in a variety of new technologies, from USB (upper surface blowing) high-lift technology, which is essential for realization of the STOL aircraft, to computer flight control technology. Comprehensive research also planned in this program includes development of the "Asuka" low-noise STOL experimental aircraft and its flight experiments, for the purposes of demonstrating the results of the aforementioned research and verifying the feasibility of the new technology.

With the domestically-developed C-1 jet transport as its prototype, the "Asuka" experimental aircraft has undergone design modifications and reworking to incorporate various new technologies. The Agency of Industrial Science and Technology and MITI, with assistance from the Aerospace Technology Research Institute, developed the FJR-710 fan-jet engine for the "Asuka." Modifications required in the FJR-710 were carried over to the FJR710-600S, four of which are being mounted on the "Asuka."

During FY 1988, flight experiments were continued over from the previous year, and, because prescribed objectives were achieved through verifying the feasibility of the STOL technology and other various new technologies, the experimental flights ended.

**Table 1-17-1. Main Dimensions of the "Asuka" Low-Noise STOL Experimental Aircraft**

| | |
|---|---|
| Overall Width | 30.6 m |
| Overall Length | 29.0 m |
| Overall Height | 10.2 m |
| Total Weight, Fully Loaded | 38.7 t |
| Engines | 4 FJR710-600S engines |
| Landing Speed | 72 knots |
| Required Runway Length | Less than 900 m |

**Table 1-17-3. "Fan-Jet STOL Aircraft Research" Budgets (Unit: ¥1 million)**

| Item | FY 1987 | FY 1988 |
|---|---|---|
| 1. Engineering Research | 70 | 0 |
| 2. Flight Experiment-Related Facilities | 0 | 0 |
| 3. Flight Experiments | 2,587 | 1,835 |
| 4 Miscellaneous | 444 | 423 |
| Total | 3,101 | 2,258 |

### 2. Aeronautical Engineering Research at the Aerospace Technology Research Institute

The Aerospace Technology Research Institute is promoting "Fan-Jet STOL Aircraft Research" as its highest priority aeronautical engineering research. The institute conducted basic and pioneering research with the emphasis on fields such as component technology for innovative, 21st century-oriented aerospace transport and on numerical simulation.

The institute also improved and maintained the large test research facilities that are required for the activities mentioned above. (Refer to the introduction of Part 3 for information about the Aerospace Technology Research Institute.)

(From the Space Activities Planning Commission of the Research and Development Bureau)

## Chapter 18. Promoting Earth Science and Technology

### 1. Promoting Earth Observation Technology R&D

#### (1) Promoting Research on Remote Sensing Technology

Because information can be simultaneously obtained over a wide area through observations made with sensors mounted on artificial satellites and aircraft, remote sensing is expected to be effectively used in a broad range of fields, such as understanding the oceans, resource exploration, and environmental management. In particular, artificial satellites enable systematic, continuous, and non-disruptive observations on a global scale. Remote sensing, in its relation to the accumulation of the information needed in the elucidation of global-scale phenomena, is an extremely effective observational device.

Consequently, our country is also taking up the challenge of earth observation using artificial satellites, with the Science and Technology Agency and the National Space Development Agency at the core of concerned organizations.

In particular, following the "Meeting to Investigate Technology for Deciphering Resource Satellite Data" that was set up by the Research Regulation Bureau (at that time) in 1970, the Science and Technology Agency has been eagerly promoting artificial satellite R&D and the utilization of satellite data. Currently, the "Council on Remote Sensing Promotion," which is composed of academic and other professionals, is held for the purpose of planning and drafting comprehensive policies on remote sensing. The Liaison Council on Remote Sensing is also continuing to be held for the purpose of comprehensively coordinating policies of related ministries and agencies.

During FY 1988, two subcommittees were formed within the Council on Remote Sensing Promotion, and studies commenced on satellite remote sensing and other technology required for research in earth science and technology. Promotion of the following two research efforts continued: "Research on the Development of Marine Remote Exploration Technology," which aims at establishing technology for utilizing remote sensing in marine observations; and "Joint Research with ASEAN Countries on the Advancement of Remote Sensing Technology and its Applications," an international joint research project for utilizing satellite data in ASEAN countries. Other activities include training analysts and conducting research on the practical employment of earth observation systems.

As for earth observation satellites, the National Space Development Agency has been using the No 1 marine observation satellite (MOS-1), our country's first earth observation satellite which was launched in February 1987, and is promoting the development of the No 1-b marine observation satellite (MOS-1b) and the No 1 earth resources satellite, whose target launch dates are in the winter of FY 1989 and the winter of FY 1991, respectively. Furthermore, research on the development of an earth observation platform engineering satellite (ADEOS) is moving along, with an approximate target launch date in FY 1994. The objectives for ADEOS are to promote cooperation in earth observation fields by appealing for international contributions in on-board sensors, assistance in global environmental surveillance, and the upkeep and development of earth observation technology. Also, direct transmissions from our country's MOS-1, America's Landsat, and France's SPOT satellites are now being received.

Because the oceans have a tremendous influence on the earth's environment, we are promoting R&D efforts on the marine observation technology that is needed for three-dimensional understanding and elucidation of wide-ranging marine fluctuation phenomena.

#### (2) Promoting Research on the Elucidation of Phenomena

To shed light on all global-scale phenomena and to aid in predicting future fluctuations, the Coordination Funds for Promoting Science and Technology are being employed in the implementation of "International Joint Research on Atmospheric and Marine Fluctuations in the Pacific Ocean and Climatic Fluctuations," "Joint Research with ASEAN Countries on the Advancement of Remote Sensing Technology and its Applications," and other efforts.

(From the Space Activities Planning Commission of the Research and Development Bureau, and the Space Utilization Office of the Comprehensive Research Division of the Earth Science and Technology Promotion Office)

### 2. Promoting R&D in Disaster Prevention Science and Technology

#### (1) Research at the National Research Center for Disaster Prevention

The Science and Technology Agency aggressively promotes disaster prevention as an important research field whose objectives are both to elucidate the intrinsic qualities of disasters and prevent disasters and also to alleviate and recover from damages. That is to say, the agency regulates guidelines on estimating costs associated with disaster prevention-related R&D for concerned ministries and agencies, promotes research at the National Research Center for Disaster Prevention, and promotes research on disaster prevention science and technology using the Coordination Funds for Promoting Science and Technology.

The National Research Center for Disaster Prevention, our country's comprehensive and core research organization for disaster prevention science and technology, implemented the following special research efforts during FY 1988.

1) Research on crustal activities in the southern Tokyo metropolitan area
2) Research on crustal activities in the Kanto and Tokai regions
3) Research on the mechanisms of earthquake occurrences
4) Research for forecasting massive ocean-trench-type earthquakes
5) Research on methods for predicting ground earthquake damage
6) Research on the development of lifestyle-related technology for preventing snow damage
7) Research on elucidation of the mechanisms of snow-drift occurrences and snow-drift disaster prevention technology
8) Research on the mechanisms of meteorological disaster occurrences and impact assessments

Other efforts that have been implemented in addition to the aforementioned include: research that covers the whole field of disaster prevention, such as wind and flood damage and coastal disaster prevention; joint research that makes use of large facilities for earthquake-resistance and rainfall experiments; and research supported by the Coordination Funds for Promoting Science and Technology.

### (2) Promoting Earthquake Prediction Research

#### a) Earthquake Prediction Systems

Based on the "Basic Research and Development Program for Disaster Prevention" that was established by the Prime Minister, our country's earthquake prediction, observation, and research activities comply with the spirit of the earthquake prediction program proposed by the Geodesy Council. These activities have been promoted with the cooperation of related government organizations and national universities.

On the other hand, the Earthquake Prediction Promotion Headquarters was established in the Cabinet in October 1976 after the possibility of an earthquake occurring in the Tokai region during that year was indicated. With close cooperation from related ministries and agencies, the headquarters, headed by the director-general of the Science and Technology Agency, aggressively promotes important policies in connection with promoting earthquake prediction.

#### b) Regions Targeted for Intensification of Earthquake Disaster Prevention Measures Based on the Special Law for Coping with Large-Scale Earthquakes

In accordance with the "Special Law for Coping with Large-Scale Earthquakes" that was instituted in June 1978, the Tokai region was designated in August 1979 as the core region targeted for intensification of earthquake disaster prevention measures. Accordingly, emergency earthquake disaster prevention measures are to be taken by the designated region in response to warning announcements that are prompted by earthquake predictions. Thus, the role of forecasting with respect to earthquake disaster prevention has become all the more important.

#### c) Earthquake Prediction-Related Budget

For FY 1989, approximately ¥ 6 billion was allocated in the overall national budget, as shown in Table 1-18-1, and, with the addition of money from the Coordination Funds for Promoting Science and Technology, observation and research activities for earthquake prediction are being further promoted.

**Table 1-18-1. FY 1989 Earthquake Prediction-Related Government Budget**
**(Unit: ¥ 1 million)**

| Organization in charge | FY 1988 budget | FY 1989 budget | Summary | |
|---|---|---|---|---|
| Science and Technology Agency | | | | |
| Research and Development Bureau | 5 | 5 | Promotion of earthquake prediction | 5 (5) |
| | 924 | 1,057 | Research on seismic activity in the southern Tokyo metropolitan area | 177 (170) |
| | | | Research on seismic activity in the Kanto and Tokai regions | 551 (475) |
| | | | Research on the mechanisms of earthquake occurrences | 177 (129) |
| | | | Research for forecasting massive ocean-trench-type earthquakes | 37 (39) |
| | | | Research on predicting volcanic eruptions | 70 (67) |
| | | | Earthquake prediction research operations and maintenance | 36 (35) |
| | | | Maintaining facilities for observing crustal activity in lower strata | 0 (9) |

**Table 1-18-1. FY 1989 Earthquake Prediction-Related Government Budget (Unit: ¥ 1 million) (Continued)**

| Organization in charge | FY 1988 budget | FY 1989 budget | Summary | |
|---|---|---|---|---|
| | | | Maintaining facilities for observing crustal activity throughout urban prefectures | 10 (0) |
| Total | 928 | 1,062 | 114.4% in comparison with that of the previous year | |
| Ministry of Education, Science and Culture | | | | |
| National universities | 1,705 | 1,790 | Promotion of comprehensive observation and research projects and basic surveys | 278 (246) |
| | | | Maintaining a mild-earthquake-observation network and improvements to comprehensive continental-earthquake-observation equipment | 349 (343) |
| | | | Gathering various kinds of earthquake prediction data through existing observation networks and conducting analytical research | 1,163 (1,115) |
| Total | 135 | 125 | 105.0% in comparison with that of the previous year | |
| Ministry of International Trade and Industry | | | | |
| Geological Survey of Japan of the Agency of Industrial Science and Technology | 135 | 125 | Geological and geochemical research on earthquake prediction | 0 (135) |
| | | | Research on the locations and mechanisms of earthquake occurrences | 125 (0) |
| | 135 | 125 | 92.1% in comparison with that of the previous year | |
| Ministry of Transportation | | | | |
| Maritime Safety Agency | 25 | 25 | Geodetic and tidal observation | 23 (22) |
| | | | Observation of geomagnetism and earth's electric currents | 2 (2) |
| Meteorological Agency | 1,257 | 1,313 | Administrating the maintenance and operations of regular monitoring systems in Tokai and other regions | 258 (196) |
| | | | Administrating the operations and maintenance of small, medium, and large earthquake-observation networks | 368 (400) |
| | | | Administrating the operations and maintenance of comprehensive systems for monitoring seismic activities | 242 (235) |
| | | | Administrating the operations and maintenance of tidal observation services in coastal areas | 68 (116) |
| | | | Administrating the maintenance and operations of a system for transmitting earthquake data | 261 (226) |
| | | | Administrating the operations and maintenance of services for observing geomagnetism and earth's electric currents | 98 (67) |
| | | | Comprehensive research on the practicalization of predicting the types of earthquakes that arise directly below the ground's surface | 17 (17) |
| Total | 1,281 | 1,338 | 104.4% in comparison with that of the previous year | |
| Ministry of Construction | | | | |
| Geographical Survey Institute | 1,565 | 1,602 | Precision geodesic network surveying in the Japanese archipelago | 1,029 (1,008 |
| | | | Observation of specified regions | 218 (212) |
| | | | Observation of the regions marked for intensified observation | 225 (219) |
| | | | Operating costs for the International Resource-Fair Exploratory Development Program | 41 (38) |
| | | | Astronomical, leveling, gravity and other types of surveying | 88 (88) |
| Total | 1,565 | 1,602 | 102.4% in comparison with that of the previous year | |

**Table 1-18-1. FY 1989 Earthquake Prediction-Related Government Budget (Unit: ¥ 1 million) (Continued)**

| Organization in charge | FY 1988 budget | FY 1989 budget | Summary | |
|---|---|---|---|---|
| Ministry of Posts and Telecommunications | | | | |
| Radio Research Laboratories | 87 | 104 | R&D of high-precision measuring technology using cosmic radio waves | 104 (87) |
| Total | 87 | 104 | 120.0% in comparison with that of the previous year | |
| Overall total | 5,701 | 6,020 | 105.6% in comparison with that of the previous year | |

Note 1. In addition to the aforementioned earthquake-prediction-related activities, ¥ 16 million (¥ 34 million) was appropriated for the Ministry of Education, Science and Culture's "Joint Japanese-Sino Earthquake-Prediction Research Operating Costs";
2) ¥ 18 million (¥ 17 million) was appropriated for the MITI Geological Survey of Japan's "Earthquake Ground-Water Telemeter Continuous Observation Costs";
3) ¥ 137 million (¥ 125 million) was appropriated for the Maritime Safety Agency's "Promotion of Marine Geodesy," to carry out satellite-laser range-finding observations in solitary islands;
4) ¥ 25 million (¥ 0 million) was appropriated for the Ministry of Construction Geographical Survey Institute's "GPS Satellite Orbit Tracking Equipment"; and
5) there are plans to continue "Research on Earthquake Tectonics in the Active Structural Regions of Central Japan" and "Research on Magnitude-7-Class Continental-Earthquake Prediction" with funding from the Coordination Funds for Promoting Science and Technology.

Note 2. Because the figures are rounded to the nearest ¥ 1000, the total figures do not necessarily agree with the actual sums for each ministry and agency.
From a study by the Earthquake Prediction Promotion Headquarters (May 1989)

## Chapter 19. Promoting Basic Research

### 1. Laser Science and Technology

Lasers, which were discovered in 1960, have suberb monochromaticity, directivity, and diversified functions such as being able to provide a source of intensely-high temperatures. Lasers have great possibilities in a wide range of applications and technical innovations.

Although laser measurement, holography technology, laser knives, and other applications have already reached the stage of practical use, lasers are targeted for applications in an even broader range of fields; research on laser applications is actively promoted throughout the world as well.

The Institute for Physical and Chemical Research (RIKEN) began research on lasers as soon as they were discovered. Now, its Laser Science Research Group is carrying out "Laser Science Research," which focuses on fields of chemistry which give rise to lasers ((1) research on laser-based heavy-isotope separation, (2) research on new laser technology, (3) new measurement methods R&D (4) research on critical-region laser chemistry).

During FY 1988, research on laser-based isotope-separation technology is being continued from FY 1987.

(From the Research and Development Promotion Division of the Science and Technology Promotion Bureau)

### 2. Heavy-Ion Science and Technology

Heavy-ion science research, which utilizes accelerated heavy ions, currently continues to evolve rapidly, both domestically and internationally. When highly-energized heavy ions are collided with atomic nuclei or atoms, useful data can be obtained on various phenomena resulting from the nuclear or atomic structure and from the bombardment process. Achieving such results with light ions has not been possible. Heavy ions are also considered for their applications in engineering research, such as damage testing of materials and the ion-implantation-based development of materials with new characteristics, and research related to great problems of social demand, such as the biological effects of radiation. These accelerated heavy ions are expected to play a role in a wide range of research fields, encompassing physics, chemistry, biology, engineering and medicine.

Consequently, RIKEN is conducting heavy-ion science research in close cooperation with universities. During FY 1988, as well, progress was made in heavy-ion science research using linear accelerators, ring synchrotrons, and a 160-cm cyclotron, not only in nuclear physics but also in a wide range of fields such as radiochemistry and radiobiology. Furthermore, an AVF cyclotron accelerator that precedes the ring synchrotron, which is the accelerator used for heavy-ion science, was completed in March 1989. With this, a heavy-ion accelerator of world class, in terms of acceleration energy and the variety of acceleration ions, emerged. Additionally, the construction of incidental irradiation-experiment equipment, progressed without a hitch and was completed in March 1989.

JAERI has also been using a 20MV tandem-type heavy-ion accelerator for its research since FY 1983.

(From the Technology Development Division of the Atomic Energy Bureau)

### 3. Solar Energy (Photosynthesis) S&T

With energy problems becoming more critical in recent years, the development of technology that makes efficient use of solar energy has become a subject of vital importance.

Through elucidation and application of the functions by which plants and microorganisms utilize solar energy, the "Solar Energy Scientific Research Group" at RIKEN is conducting "Solar Energy Scientific Research" ((1) the science of photosynthesis, (2) photosynthetic production, (3) optical properties of films, (4) research on organic and metallic photochemistry). The objectives of these efforts include hydrogen production, organic-substance production, and electrical energy conversion using solar energy.

Additionally, joint research based on the "Japan-US Energy Research Cooperation Agreement" with the University of Michigan and other American research organizations is being conducted, and scientific and the technical collaboration based on the Versailles Summit serves as the core research organization for the field of "Photosynthesis."

(From the Technology Development Division of the Atomic Energy Bureau)

## Chapter 20. Promoting New Technology Development and Technology Transfer

With the increase in sophistication, size, and complexity of technology in recent years, the development of new technology requires large sums of capital that extend over long periods of time. The accompanying R&D risks have also been increasing from year to year. Consequently, there is a demand for more efficient R&D promotion and the positive transfer of the resulting fruits of those efforts.

1) Commissioned Development and the Dissemination of its Results

In the development of new technology, the Research and Development Corporation of Japan gathers excellent research results from universities, national test research institutions, and other organizations; investigates and assesses the newness, economic characteristics, and marketability of these results; selects subjects for commissioned development; through advertisements and other recruitments tactics, selects enterprises that are suitable for commissioned development; and, after deciding upon development time-frames, development costs, development scales, and funding plans, begins development. When the development efforts come to an end and are successful, the financial sums for the costs of the development in question are repayed in annual installments (no interest) over a five-year period; for unsuccessful development efforts, the enterprise is exempted from repayment obligations.

2) Development Mediation

The Research and Development Corporation of Japan conducts surveys and evaluations on patents held by special corporations and individuals, in addition to the yet unused patents held by universities and national test research institutions, and acts on behalf of enterprises with respect to patents that are appropriate for commercialization. (From the Research and Development Cooperation Division of the Science and Technology Promotion Bureau)

## Chapter 21. Promoting Comprehensive Resource Utilization Policies

### 1. Putting the Reports of the Resources Board of Investigations to Practical Use

Our country, which is poor in natural resources, must work towards advanced resource utilization and conservation. In order to effectively and appropriately make the most of limited resources in striving for improvements in the citizens' standard of living, it is necessary to promote the comprehensive utilization of those resources. To that end, comprehensive resource utilization policies were put together as reports of the Resources Board of Investigations, based on the investigative deliberations of that group. For each report, explanatory meetings were held for concerned ministries and agencies, and efforts were made to promote the actualization of those policies and to influence administrative policy-making.

### 2. Promoting Basic Surveys

#### (1) Basic Survey on the Effective Utilization of Fat-Soluble Components of Foodstuffs

As the follow-up to the "Fourth Japanese Standard Food Components Chart," an investigative study was begun in FY 1986 on the fat-soluble components of fatty acids, cholesterol, and vitamin E, which are very closely associated with illnesses such as heart disease and strokes. During FY 1988, component analysis values of 154 foodstuffs were investigated.

#### (2) Basic Survey in Connection with Measures for Preserving Genetic Plant Resources

Of the pros and cons of life sciences promotion, whether or not systems that supply biological resources are to be secured without a hitch is a large point; the fact that such systems are actively being maintained in foreign countries is another point. Therefore, as one of the bases for life sciences promotion, a survey was conducted during FY 1988 in connection with measures for exchanging information on the preservation of plant genes.

### 3. Promoting FAO/WHO Joint International Food Standards Program Measures

Because of its participation in the FAO/WHO Joint International Food Standards Program, the Science and Technology Agency is holding the "Ministerial Liaison Conference on the FAO/WHO Joint International Food Standards Program" (which, in addition to the Science and Technology Agency, is comprised of the Environment Agency; the Fair Trade Commission; the Economic Planning Agency; the Ministry of Foreign Affairs; the Ministry of Finance; the Ministry of Health and Welfare;

the Ministry of Agriculture, Forestry and Fisheries; and MITI) and is dealing with international food standards-related matters.

During FY 1988, the agency was engaged in drafting comments and providing information on various standards proposals, as well as preparing materials on measures to be taken for our country's national representatives who attend the meetings.

(From the Resources Office of the Policy Division of the Science and Technology Policy Bureau)

[Chapter 22 omitted]

## Chapter 23. Scientific and Technical Research Incentives

### 1. Notable Inventions, Selection and Announcement

Although a very large number of inventions come into being every year, selecting from among those that which is technically superior and of great use in terms of practical applications is an activity which deepens interest in inventions, creates the foundation from which superb inventions are born, and is extremely important for the promotion of science and technology.

Notable Inventions is one policy for promoting the creation and cultivation of inventions. In principle, a "Notable Invention" is selected from inventions that were publicly released and for which patents were applied for within the past three years. The selection of superior inventions is based on the following viewpoints: 1) an invention which is expected to contribute to an improvement in our country's technological standards and to offer outstanding effectivation; 2) an invention which is expected to contribute to the creation of new technology, although the invention is not immediately put to practical use; 3) an invention which is expected to be have a remarkable effect on the promotion of regional industries or in the modernization of small and medium enterprises. Through this activity, R&D results are generally disseminated and the implementation of those results is facilitated; it has also contributed to the improvement of scientific and technological standards.

Since its inception in 1940, this system has been used 47 times. At the 47th Notable Inventions (announced on 11 April 1988 ), 106 inventions were selected.

(From the Dissemination and Incentives Office of the Policy Division of the Science and Technology Promotion Bureau)

### 2. Revisions to the S&T Promotion Tax System

Activation of the private sector, which plays a great role in our country's national research activities, is indispensable to facilitating our country's research activities and raising the level of technological standards. Therefore, devising appropriate taxation and financial measures is becoming a matter of utmost importance.

The following items are the principal special taxation measures for promoting S&T:

- a tax deduction system for increased test-research costs
- a tax system for facilitating basic technology R&D
- special deductions for income related to overseas technology transactions
- deductions for endowments to public corporations that further specified public interests
- performance-fee loss accounting system for the Power Reactor and Nuclear Fuel Development Corp.
- special expenditure redemptions for organizations such as the Mining and Manufacturing Technological Research Association

During FY 1988, the continuation of tax deductions on increased test research costs, the tax system for facilitating basic technology R&D, and special deductions for income related to overseas technology transactions were approved.

Incidentally, designated space-development-related facilities were newly added, starting in FY 1987, as subjects of the tax system for facilitating basic technology R&D. Also, donations to specified special public trusts are subjects of newly created system for income deduction and loss accounting that includes contributions to public corporations that further specified public interests.

(From the Policy Division of the Science and Technology Promotion Bureau)

[passages omitted]

## Chapter 24. Surveys on General Internal and External Trends

### 1. 1988 White Paper on Science and Technology

Based on surveys and analyses of scientific and technological trends, the White Paper on Science and Technology is published every year as an aid in broadening the public's understanding of the current state of scientific and technological affairs. The White Paper on Science and Technology is normally composed of three sections. The first section consists of analyses and outlines of our country's S&T activities, covering every subject of government S&T policies. The second and third sections deal with trends in S&T activities and government policies, respectively. In the first section of the 1988 White Paper, the theme of "Aiming to Establish a Creative Research Environment" was based on an international field of vision. In this section, the central subject of analysis is the present conditions in research environments that are needed to promote more creative research in our country.

The 1989 White Paper on Science and Technology is now being written.

(From the Research Division of the Science and Technology Policy Bureau)

## 2. Surveys on Scientific and Technological Research

Statistical surveys on research expenditures, numbers of researchers, and other important indicators of our country's S&T activities have been carried out every year since 1953 by the Statistics Bureau of the Management and Coordination Agency. The results of these surveys are collected and published in the "Report on Surveys of Science and Technology." These results are of importance in that they provide the basic materials that are necessary in our country's S&T promotion. The survey results for FY 1987 (natural sciences categories) are given below.

### (1) Research Expenditures

1) Total Research Expenditures

Our country's research expenditures (natural sciences categories) amounted to ¥9.0162 trillion, a nominal increase of 7.1% over that of the previous year which indicates a gradual upward tendency. If one looks at net research expenditures, following the underlying tone of stabilization after FY 1973, there was an upturn starting in FY 1976, which continued as long as FY 1987 (Table 1-24-1).

The percentage of total research expenditures with respect to national income in FY 1987 increased 3.30% over that of the previous year (Table 1-24-2).

**Table 1-24-1. Total Research Expenditures**

| Item | FY 1986 | FY 1987 |
|---|---|---|
| Total research expenditures (nominal) | ¥8.4150 trillion | ¥9.0162 trillion |
| (Rate of increase over previous year) (Note) | (3.7%) | (7.1%) |
| Total research expenditures (real) | ¥8.6131 trillion | ¥9.1721 trillion |
| (Rate of increase over previous year) (Note) | (6.1%) | (6.5%) |

(Note) The real amounts are those based on the FY 1985 standard.

**Table 1-24-2. Percentage of Total Research Expenditures (Nominal) with respect to National Income**

| Item | FY 1986 | FY 1987 |
|---|---|---|
| National income | ¥264.3094 trillion | ¥273.2483 trillion |
| Total research expenditures (nominal) | ¥8.4150 trillion | ¥9.0162 trillion |
| Ratio of Total Research Expenditures (Nominal) to National Income | 3.18% | 3.30% |

2) Breakdown of Research Expenditures

If one looks at the distribution-by-organization percentages of appropriations for research expenses in FY 1987, companies accounted for 72.0% of the appropriations, the largest percentage; research organizations, 14.6%; and universities, 13.4%. A look at the breakdown by organization of comparisons with the previous year shows an increase of 7.1% for the overall average, an increase of 6.1% for companies, an increase of 11.1% for research organizations, and an increase of 11.1% for universities (Table 1-24-3).

**Table 1-24-3. Research Appropriations by Organizations and Distribution Ratios**

| Item | FY 1986 | FY 1987 |
|---|---|---|
| Total amount | ¥8.4150 trillion | ¥9.0162 trillion |
| (Rate of increase over previous year) | (3.7%) | (7.1%) |
| (Distribution ratio) | (100.0%) | (100.0%) |
| Companies | ¥6.1202 trillion | ¥6.4943 trillion |
| (Rate of increase over previous year) | (3.0%) | (6.1%) |
| (Distribution ratio) | (72.7%) | (72.0%) |
| Research organizations | ¥1.1730 trillion | ¥1.3123 trillion |
| (Rate of increase over previous year) | (6.5%) | (11.9%) |
| (Distribution ratio) | (13.9%) | (14.6%) |
| Universities | ¥1.1219 trillion | ¥1.2096 trillion |
| (Rate of increase over previous year) | (4.3%) | (7.8%) |
| (Distribution ratio) | (13.3%) | (13.4%) |

In addition, the rise in the percentage of research expenditures with respect to sales, which indicates the vigor of research activities, was 2.59% in FY 1987, increasing 0.02 points over the previous year.

If one looks at the percentages of research expenditures shouldered by the government and the private sector, the government (national and regional public groups) bore 19.9% of the burden, and the private sector, 80.0%. In comparison to that from the previous year, the costs born by national and regional public groups increased, while that of the private sector decreased (Table 1-24-4).

**Table 1-24-4. Percentages of Research Expenditure Burdens**

| Item | FY 1986 | FY 1987 |
|---|---|---|
| Total research expenditures (nominal) | ¥8.4150 trillion | ¥9.0162 trillion |
| (Percentage) | (100.0%) | (100.0%) |
| National and regional public groups | ¥1.6517 trillion | ¥1.7983 trillion |
| (Percentage) | (19.6%) | (19.9%) |
| Private sector | ¥6.7557 trillion | ¥7.2101 trillion |
| (Percentage) | (80.3%) | (80.0%) |
| Foreign countries | ¥7.6 billion | ¥7.8 billion |
| (Percentage) | (0.1%) | (0.1%) |

If one looks at the percentages of research expenditures with respect to the nature of the research, i.e., basic research, applied research, and developmental research, the highest was developmental research, which accounted for 61.7%, followed by applied research, and then by basic research, which increased in comparison to the previous year (Table 1-24-5).

**Table 1-24-5. Percentages of Research Expenditures with respect to the Nature of the Research**

| Item | FY 1986 | FY 1987 |
|---|---|---|
| Total | 100.0% | 100.0% |
| Basic research | 13.3% | 14.0% |
| Applied research | 24.4% | 24.3% |
| Developmental research | 62.3% | 61.7% |

Looking at the breakdown of research expenditures by research objective, a growth in high research costs for space development and information processing can be seen (Table 1-24-6).

**Table 1-24-6. Research Expenditures with respect to Objectives**

| Item | FY 1986 | FY 1987 |
|---|---|---|
| Nuclear power development | ¥399.9 billion | ¥421.2 billion |
| (Rate of increase over previous year) | (14.7%) | (5.3%) |
| Space development | ¥158.7 billion | ¥171.0 billion |
| (Rate of increase over previous year) | (4.4%) | (7.8%) |
| Ocean development | ¥50.7 billion | ¥61.2 billion |
| (Rate of increase over previous year) | (24.7%) | (20.8%) |
| Information processing | ¥492.8 billion | ¥604.7 billion |
| (Rate of increase over previous year) | (9.7%) | (22.7%) |
| Environmental protection | ¥151.6 billion | ¥154.5 billion |
| (Rate of increase over previous year) | (1.1%) | (1.9%) |
| Life sciences | ¥909.6 billion | ¥1,001.5 billion |
| (Rate of increase over previous year) | (3.9%) | (10.1%) |

If one looks at our country's research expenditures per researcher, the figure was ¥21.55 million in FY 1987. The nominal expense increased 3.9% over that of the previous year (Table 1-24-7).

**Table 1-24-7. Research Expenditures Per Researcher**

| Item | FY 1986 | FY 1987 |
|---|---|---|
| Overall | ¥20.75 million | ¥21.55 million |
| (Rate of increase over previous year) | (-2.6%) | (3.9%) |
| (Real rate of increase) | (-0.2%) | (3.2%) |
| Companies | ¥24.31 million | ¥24.90 million |
| Research organizations | ¥36.14 million | ¥39.46 million |
| Universities | ¥9.25 million | ¥9.74 million |

3) Research Expenditures with respect to Organization

A. Corporate research expenditures

If one looks at corporate research expenditures with respect to industry, manufacturing industries accounted for 93.9% of all of the industrial research expenditures (Table 1-24-8). Among the manufacturing industries, electric machinery industries accounted for 33.3%, the largest percentage, followed by chemical industries at 16.9%, and the tranportation machinery industry at 14.9%. These three kinds of industries accounted for 65.1% of the overall research expenditures.

**Table 1-24-8. Corporate Research Expenditures with respect to Industry**

| Item | FY 1986 | FY 1987 |
|---|---|---|
| All industries | 100.0% | 100.0% |
| Agriculture, forestry, and fisheries | 0.1% | 0.1% |
| Mining | 0.4% | 0.3% |
| Construction | 2.0% | 2.0% |
| Manufacturing | 93.8% | 93.9% |
| Transportation, communications, and public service | 3.8% | 3.7% |

B. Research organizations' research expenditures

During FY 1987, research expenditures in natural science departments of research organizations amounted to ¥1.3123 trillion, an increase of 11.9% over that of the previous year.

Research expenditures for state-run research organizations amounted to ¥297.4 billion; publicly-managed research organizations, ¥201.3 billion; privately-managed research organizations, ¥398.3 billion; and research organizations of special corporations, ¥415.3 billion (Table 1-24-9).

**Table 1-24-9. Research Organizations' Research Expenditures**

| Item | FY 1986 | FY 1987 |
|---|---|---|
| Overall | ¥1.1730 trillion | ¥1.3123 trillion |
| (Rate of increase over previous year) | (6.5%) | (11.9%) |
| State-run | ¥236.7 billion | ¥297.4 billion |
| (Rate of increase over previous year) | (4.1%) | (25.7%) |
| Publicly-managed | ¥193.6 billion | ¥201.3 billion |
| (Rate of increase over previous year) | (0.3%) | (4.0%) |
| Privately-managed | ¥360.4 billion | ¥398.3 billion |
| (Rate of increase over previous year) | (13.9%) | (10.5%) |
| Special corporations | ¥382.3 billion | ¥415.3 billion |
| (Rate of increase over previous year) | (5.0%) | (8.6%) |

C. Research expenditures of universities

Research expenditures in natural sciences departments of universities amounted to ¥1.2096 trillion, an increase of 7.8% over that of the previous year.

Looking at the breakdown by academic fields within natural sciences departments, health-related fields had the highest expenditures, ¥511.0 billion, followed by engineering departments, with research expenditures of ¥431.4 billion.

Looking at the breakdown by organization, national universities' ¥660.0 billion of research expenditures accounted for 54.6% of the total; public universities' ¥61.9 billion, 5.1%; and private universities' ¥487.7 billion, 40.3% (Table 1-24-10).

**Table 1-24-10. Universities' Research Expenditures**

| Item | FY 1986 | FY 1987 |
|---|---|---|
| Overall | ¥1.1219 trillion | ¥1.2096 trillion |
| (Rate of increase over previous year) | (4.3%) | (7.8%) |
| National universities | ¥610.8 billion | ¥660.0 billion |
| (Rate of increase over previous year) | (3.7%) | (8.0%) |
| Public universities | ¥57.5 billion | ¥61.9 billion |
| (Rate of increase over previous year) | (2.2%) | (7.6%) |
| Private universities | ¥453.5 billion | ¥487.7 billion |
| (Rate of increase over previous year) | (5.5%) | (7.5%) |

**(2) Research-Related Personnel Numbers**

At present, 1 April 1988, there are 715,000 people (the total number of researchers, research assistants, technicians, clerical and other research-related personnel) engaged in research-related activities in our country's natural sciences departments.

Among these, the number of researchers (regularly employed) increased 5.6% since last year, from 418,000 to 442,000.

Looking at the breakdown by organization, 279,000 researchers working in companies accounted for 63.2% of the total number; 34,000 in research organizations, 7.8%; 128,000 in universities, 29.0%.

(From the Research Division of the Science and Technology Policy Bureau)

**3. National Test Research Occupation Program**

To get a timely grasp on trends in the nation's test research, a yearly survey is conducted, with the cooperation of related ministries and agencies, on test research programs in national and other test research institutions. This survey is put together and publlished as the "National Test Research Occupation Program."

This booklet covers comprehensive R&D efforts carried out by related ministries and agencies; special and ordinary research at national test research institutions; special research supported with Funds for Nuclear Power Test Research in National Organizations and Funds for Pollution Prevention and Other Test Research in National Organizations; and other test research that is carried out by test research organizations. With regard to these areas, information on research subjects, research contents, yearly programs, organizations in charge, and research expenditures is published in the booklet. (From the Coordination Division of the Science and Technology Policy Bureau)

**4. Trends in Technology Imports**

To get a grasp on trends in technology imports in our country, the Institute for Research on Science and Technology Policy puts together an outline on overseas technology imports for every fiscal year, based on reports made to the Bank of Japan in connection with technology imports.

Looking at the number of overseas technology imports during FY 1987, there were 2,709 new import contracts and 1,236 cases of modified contracts. Of the latter, 967 cases involved modifications to the contents of existing contracts, and the remainder involved job succession (the person in charge of the contract changed).

Looking at the 2,709 new import contracts in terms of technology classifications, there were 2,636 cases of import contracts for manufacturing industries, accounting for the largest share (97.3%). In a further breakdown, there were 1,274 contracts for electrical machines and tools (48.3%); 283 contracts for general machines and tools (10.7%); 229 contracts for clothing and textile products (8.7%); 210 contracts for chemical products (8.0%); and 161 other contracts (6.1%).

Looking at the 2,709 new import contracts in terms of the countries from which products were exported, there were 1,613 cases of imports from the US, by far the largest (59.5%); followed by France, with 218 (8.0%); West Germany, with 192 (7.1%); and England, with 184 (6.8%). Exports from these four countries account for 81.5% of the total imports. (From the Institute for Research on Science and Technology Policy)

[Chapter 25 omitted]

## Part II. Outline of Advisory Organizations

### Chapter 1. Council for Science and Technology

#### (1) Outlook

The Council for Science and Technology is an advisory organ within the Prime Minister's office which was established in February 1959 as the highest deliberative organ in connection with S&T policies in our country. In response to inquiries from the Prime Minister, the council formulates general, basic, and comprehensive S&T policies; decides long-term, comprehensive R&D objectives; submits reports on the bases on which policies are made in order to carry out these R&D objectives; and offers opinions as the need arises.

#### (2) Organization

At present, 31 March 1989, the members and organization of the Council for Science and Technology are as follows.

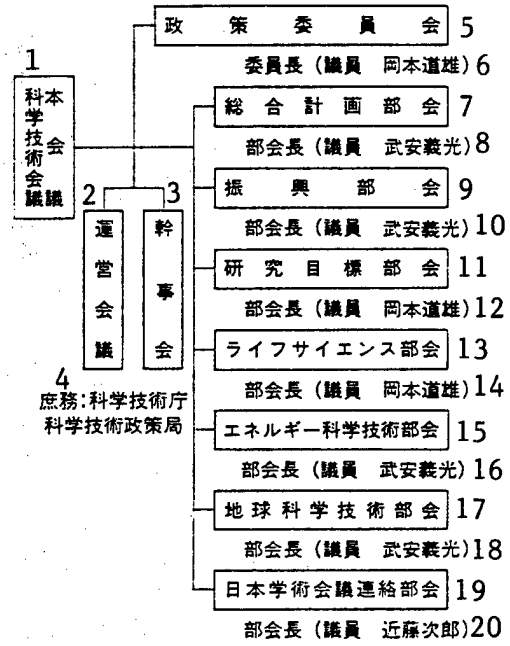
| (Members) | | |
|---|---|---|
| Chairman | Prime Minister | Noboru Takeshita |
| Member | Minister of Finance | Tatsuo Murayama |
| " | Minister of Education, Culture, and Science | Takeo Nishioka |
| " | Director-general of the Economic Planning Agency | Koichiro Aino |
| " | Director-general of the Science and Technology Agency | Shigeichi Miyazaki |
| " | Chairman of the Science Council of Japan | Jiro Kondo |
| " | (full-time council member) | Michio Okamoto |
| " | (full-time council member) | Yoshimitsu Takeyasu |
| " | Adviser to the Nippon Telegraph and Telephone Corp. | Yasusada Kitahara |
| " | President of the Kansai Electric Power Co. | Seiji Morii |
| " | Chairman of the East Japan Railway Co. | Isamu Yamashita |

#### (3) State of Activities

1) Report in response to Inquiry No 15

Electronics and information science and technology plays a pioneering role in technological innovation and is a field which our country should overwhelmingly promote. In particular, we must aggressively promote R&D within a basic program, henceforth emphasizing fundamental fields.

**Figure 2-1-1. Organizational Chart**




Key:—1. Council for Science and Technology plenary session—2. Standing council—3. Board of governors—4. Miscellaneous affairs: Science and Technology Agency Policy Division—5. Policy Committee—6. Committee chairman (Member Michio Okamoto)—7. General Planning Division—8. Division head (Member Yoshimitsu Takeyasu)—9. Promotion Division—10. Division head (Member Yoshimitsu Takeyasu)—11. Research Objectives Division—12. Division head (Member Michio Okamoto)—13. Life Sciences Division—14. Division head (Member Michio Okamoto)—15. Energy S&T Division—16. Division head (Member Yoshimitsu Takeyasu)—17. Earth S&T Division—18. Division head (Member Yoshimitsu Takeyasu)—19. Science Council of Japan Liaison Division—18. Division head (Member Jiro Kondo)

In coping with these kinds of circumstances, the Council for Science and Technology formulated the report entitled "On the Basic Research and Development Program for Electronics and Information Science and Technology," on 14 March 1989 in response to Inquiry No 15.

This report focused on important R&D subjects and promotional policies, the scope of which covers the next 10 or so years. As basic viewpoints to be taken in promoting R&D, it gave serious consideration to: 1) the promotion of fundamental and creative R&D, 2) the positive application of R&D results; 3) harmonization with humanity and society.

2) Inquiry No 16

With the promotion of abundantly creative S&T as an objective, the Prime Minister submitted Inquiry No 16,

"On the Basic Guidelines for Maintaining the Scientific and Technological Promotional Base," to the Council for Science and Technology in January 1988. The purpose of this inquiry was to strengthen the foundation that supports scientific and technological activities.

In response to this inquiry, the Council for Science and Technology set up a Base Maintenance Subcommittee within its General Planning Division and is furthering its investigations in fields, with the exception of life sciences fields. Studies on matters pertaining to the life sciences fields are handled by the Biology Base Maintenance Subcommittee, which the council established within the Life Sciences Division.

3) Inquiry No 17

Earth S&T deepens the understanding of the vast environment surrounding mankind; from the viewpoint of searching out the possibilities for application of that knowledge, it is an important field of S&T. Furthermore, it is important as a base for coping with the destruction of the ozone layer, global warming, and other "global environmental problems," which have also been taken up as social problems in recent years. Based on this kind of situation, the Prime Minister submitted Inquiry No 17, "On the Basic Research and Development Program for Earth Science and Technology," to the Council for Science and Technology in March 1989. Upon receiving this inquiry, the council set up the Earth Science and Technology Division and is furthering its investigations.

4) State of primary activities in the Policy Committee

A. Policy Committee establishment and composition

Amidst increasingly severe domestic and international conditions, there has been increasingly deeper appreciation of the importance of S&T as the key to solving economic and social problems. With this growing appreciation, functional strengthening of the Council for Science and Technology has been called for in reports such as the Provisional Commission for Administrative Surveys Basic Report of July 1982.

As a result, in the 33rd plenary session of the Diet (March 1983), the Policy Committee, a group of learned individuals from various fields, was inaugurated. The purpose of this committee is to deal promptly and precisely with important S&T policy matters that arise in CST meetings and thereby facilitate the evolution of fluid and flexible S&T policies.

The Policy Committee's constituent members (14 individuals) are as follows (at present, 31 March 1989).

**(Members)**

| | | |
|---|---|---|
| Committee chairman | Yasusada Kitahara | (Adviser to the Nippon Telegraph and Telephone Corp.) |
| Committee member | Seiji Morii | (President of the Kansai Electric Power Co.) |
| " | Isamu Yamashita | (Chairman of the East Japan Railway Co.) |
| " | Jiro Kondo | (Chairman of the Science Council of Japan) |
| " | Hiroshi Inose | (Director of the Japan Information Center on Science and Technology) |
| " | Kunio Kagayama | (Managing director of the Agriculture, Forestry, and Fisheries Technology Information Association Co.) |
| " | Machiro Kawada | (Adviser to Suzuki Motor Co.) |
| " | Masakazu Sawa | (Consultant for Toshiba Corp.) |
| " | Eiji Suzuki | (Chairman of Mitsubishi Chemical Industries Ltd.) |
| " | Saburo Nagakura | (Director of Okazaki National Joint Research Organization) |
| " | Hiromichi Miyazaki | (Adviser to Dai-Ichi Kangyo Bank Ltd.) |
| " | Yoshio Yanase | (Sophia University Professor) |

B. Principal activities of the Policy Committee

(i) Fundamental studies for formulating S&T policies

To aid in the Policy Committee's deliberations and investigations, hearings were held with related ministries and agencies on the state of affairs in connection with S&T policies. In addition, round-table discussions were conducted with those in charge of overseas policy-making, and ideas on how S&T policies should be formulated were exchanged.

Using the Coordination Funds for Promoting Science and Technology, the actual state of the S&T promotion base was investigated; detailed studies were conducted on the concepts of international fundamental research programs; and fundamental data to aid in studies on various policy subjects was obtained.

(ii) Coordinating the promotion of important research operations

In working towards scientific and technological evolution that is in tune with the entire nation, the Coordination Funds for Promoting Science and Technology were

created in FY 1981. In May 1987, the following keypoints provided the basis on which the actual management of the Coordination Funds was carried out in FY 1988:

- focusing on the promotion of fundamental and pioneering fields of S&T, with emphasis on substance and materials S&T and the life sciences, and due consideration for coping with earth S&T fields;
- promoting powerful R&D to meet national and social needs;
- actively promotely international joint research;
- promoting fundamental research in the national research institutes;
- perfecting the investigative analyses that are needed in reviewing R&D promotional policies and selecting research topics.

(iii) Dealing with important policy items

a. In building upon the basic directions indicated in Report No 11, the "Priority Guidelines on FY 1989 Science and Technology Promotion" was put together in July 1988. This compilation of opinions on what should be primarily implemented in S&T promotion contained the following keypoints: 1) the promotion of fundamental and pioneering S&T and the repletion of creative human talent, 2) expanding international exchange and cooperation, 3) reinforcing the S&T promotion base and facilitating research exchange. The guidelines called for a multipronged approach to the promotion of these efforts.
b. Follow-up to Report No 13

As a follow-up to Report No 13, "On Mid to Long-Range Models for National Test Research Institutions" (August 1987), the Policy Committee established the Subcommittee for Studies on the Activation of National Test Research Institutions in October 1988. This subcommittee is conducting surveys and studies on the actual state of implementation of the report and on future subjects that are geared towards the actualization of the report's objectives.

c. Promoting the Human Frontier Science Program

Further studies are being carried out on the internationally cooperative promotion of the "Human Frontier Science Program," a program initiated by our country for the purpose of supporting and furthering the fundamental research that focuses on elucidating the superb functions of living organisms and uncovering a historically new area with respect to S&T advancement.

5) Primary activities of the Life Sciences Division

In connection with the theme of harmonization between S&T on one hand and humanity and society on the other, the Life Sciences Division set up the Conference on Life Sciences and Humanity and is deliberating the basic ways of thinking about this subject.

The Life Sciences Division is also conducting surveys and deliberations on the "Guidelines for Recombinant DNA Experimentation" (decided upon by the Prime Minister in August 1979), always basing these efforts on the latest scientific knowledge.

In addition, with respect to the safety assessments required in the expansion of these guidelines, the Life Sciences Division is carrying out investigations on the safety of experimentation and other activities and is endeavoring to add to its accumulated scientific knowledge.

(From the Planning Division of the Science and Technology Policy Bureau)

## Chapter 2. Atomic Energy Commission

### (1) General Situation

The Atomic Energy Commission was established within the Prime Minister's Office in January 1956. Its objectives are the democratic management of atomic energy administration and the systematic enforcement of national policies on atomic energy research, development, and utilization, in accordance with the Basic Law on Atomic Energy. The Atomic Energy Commission has the authority to plan programs, deliberate, and make decisions on matters related to the following areas.

1) Atomic energy utilization policies
2) The comprehensive coordination of concerned administrative organs in connection with atomic energy utilization
3) The estimation of operating costs and apportionment programs for concerned administrative organs in connection with atomic energy utilization
4) The regulation of nuclear fuel materials and reactors (excluding that which the Nuclear Safety Commission oversees)
5) Encouraging test research in connection with atomic energy utilization
6) The education and training of researchers and technicians for activities in atomic energy utilization
7) The gathering of information and the publishing of statistics and surveys on atomic energy utilization
8) Other important atomic-energy-utilization-related matters not mentioned above (excluding that which the Nuclear Safety Commission oversees)

The Prime Minister must give mature consideration to items the commission decides upon in its reports to him. The commission can also make recommendations through the Prime Minister to concerned administrative organizations as the need arises.

### (2) Organization

The Atomic Energy Commission is headed by the director-general of the Science and Technology Agency and is composed of four other members who are appointed by

the Prime Minister with the approval of the Diet (up to two of these members serve on a part-time basis). At present, on 31 March 1989, the composition is as follows.

| | | |
|---|---|---|
| Commission chairman | Shigeichi Miyazaki | (Director-general of the Science and Technology Agency) |
| Member | Takashi Mukaibo | (Full-time) |
| | Masamitsu Kadota | (Part-time) |
| | Toshiaki Nakae | (Full-time) |
| | Akira Oyama | (Full-time) |

Special participants (up to 25 part-time individuals), who take part in social affairs, and expert committee members (part-time), who investigate and deliberate specialized matters, are organized within the Atomic Energy Commission. Currently, at the end of March 1989, these special divisions are as follows.

**Table 2-2-1. Summary of Experts Groups within the Atomic Energy Commission (At the end of March 1989)**

| Name | Date Established | Members | Group Leader |
|---|---|---|---|
| (1) Fusion Council | 11 November 1975 | 14 | Tatsuoki Miyajima |
| (2) International Atomic Energy Problems Round-Table Discussion Group | 7 March 1978 | 23 | Yoshikazu Ashiwara |
| (3) Reprocessing Promotion Round-Table Discussion Group | 18 May 1984 | 17 | Takashi Mukaibo |
| (4) Uranium Enrichment Round-Table Discussion Group | 17 December 1985 | 15 | Takashi Mukaibo |
| (5) Fast Breeder Reactor Development Program Experts Group | 27 May 1986 | 14 | Hiroshi Murata |
| (6) Radiation Utilization Experts Group | 18 July 1986 | 17 | Shinnobu Saito |
| (7) Basic Technology Promotion Experts Group | 11 September 1987 | 24 | (Note) |
| (8) Radioactive Waste Measures Experts Group | 27 November 1987 | 22 | Toyoro Ikuta |

(Note: Because Mr Keiichi Oshima, a group leader, passed away, this seat is currently, at the end of March 1989, vacant.

### (3) State of Activities

1) In Connection with Basic Atomic Energy Policies

Regarding the FY 1989 Basic Program for Atomic Energy Development and Utilization, concluded 17 March 1989

2) In Connection with Atomic-Energy-Related Budgets

A. Regarding FY 1989 Atomic-Energy-Related Budget Processing, concluded 7 June 1988

B. Regarding Estimating FY 1989 Atomic-Energy-Related Costs, concluded 31 September 1988

3) Miscellaneous

A. Regarding the Establishment of the Atomic Energy Damage Compensation System Special Division, concluded 2 August 1987
B. Regarding the Atomic Energy Commission's Invitations to Overseas Atomic-Energy-Related Personnel during FY 1988, concluded 30 September 1987
C. Regarding the FY 1988 Annual Report on Atomic Energy, concluded 29 November 1987
D. Regarding Revisions to the Atomic Energy Damage Compensation System, concluded 6 December 1988
E. Regarding the Atomic Energy Commission's Invitations to Overseas Atomic-Energy-Related Personnel during FY 1988, concluded 7 January 1989
F. Regarding the Atomic Energy Commission's Invitations to Overseas Atomic-Energy-Related Personnel during FY 1988, concluded 17 March 1989

(In addition to the aforementioned, 20 reports were submitted in connection with permission for nuclear reactor establishment/modification and other such matters.)

(From the Atomic Energy Research Office of the Policy Division of the Atomic Energy Bureau)

**Major Reports Submitted by the Atomic Energy Commission during FY 1988**

| Subject | Date of Report | Contents |
|---|---|---|
| "Regarding Nuclear Reactor Establishment/Modification at the Power Reactor and Nuclear Fuel Development Corp.'s Fugen Advanced Thermal Converter Power Plant (Modifications to the ATR Facilities)" | 12 July 1988 | This case involves loading an gadolinium fuel assembly for irradiation use as part of the ATR's high-burnup-fuel development. |
| "Regarding Nuclear Reactor Establishment/Modifications at the Reactors of Chubu Electric Power Co.'s Hamaoka Nuclear Power Plant (Enlarging the No 4 Reactor and Modifying the No 1, No 2, and No 3 Reactors)" | 19 July 1988 | This case involves enlarging the No 4 reactor and setting up incinerators for combustible solid wastes in the No 1, No 2, and No 3 reactors. |
| "Regarding Authorization for Nuclear Fuel Material Processing at the Japan Nuclear Fuel Industries Co.'s Rokkasho Plants" | 22 July 1988 | This case involves the establishment of commercial uranium-enrichment plants as a part of starting a nuclear fuel cycle in Japan. |
| "Regarding the Establishment of a Nuclear Reactor at the Hokuriku Electric Power Co.'s Noto Power Plant" | 8 August 1988 | This case involves the new construction of a boiling water reactor with a thermal output of 1,600 MW in Shiga Town, Hanesa District, Ishikawa Prefecture. |
| "Regarding Nuclear Reactor Establishment/Modification at JAERI's Tokai Laboratory (STACY, Static Critical Assembly; TRACY, Transition Critical Assembly)" | 30 September 1988 | This case involves the establishing the STACY and TRACY facilities for the purposes of gathering basic data on criticality and on critical transitional phenomena, respectively, in connection with nuclear fuel cycle facilities. |
| "Regarding Nuclear Reactor Establishment/Modifications at the Tohoku Electric Power Co.'s Onagawa Nuclear Power Plant (Enlarging the No 2 Reactor)" | 10 February 1989 | This case involves the enlargement of the boiling water reactor, which will have a thermal output of 2,440 MW, at the Tohoku Electric Power Co.'s Onagawa Nuclear Power Plant. |

## Chapter 3. Nuclear Safety Commission

### (1) General Situation

The Nuclear Safety Commission was established within the Prime Minister's Office on 4 October 1978 when the "Law on Partial Revisions to the Basic Law on Atomic Energy" came into effect.

The Nuclear Safety Commission, together with the Atomic Energy Commission, was established as an organization for the democratic management of atomic energy administration and the systematic enforcement of national policies on atomic energy research, development, and utilization. The Nuclear Safety Commission has the authority to plan programs, deliberate, and make decisions in connection with the following matters.

1) Atomic energy utilization policies in connection with regulations for ensuring safety.
2) Safety regulations for nuclear fuel materials and reactors.
3) Fundamentals of disaster-prevention attendant upon atomic energy utilization.
4) Basic measures for preventing disasters due to radioactive fallout.
5) In addition to that mentioned in items 1, 2, and 3 above, important safety-regulation-related matters in connection with atomic energy utilization.

The Prime Minister must give mature consideration to matters the commission decides upon in its reports to him. When the need arises, the commission can also make recommendations through the Prime Minister to concerned administrative organizations.

### (2) Organization

Five members, who are appointed by the Prime Minister with the approval of the Diet, make up the commission; the head of the commission is elected by its full-time members. At present, on 31 March 1989, the composition is as follows.

**Nuclear Safety Commission Members**

| | | |
|---|---|---|
| Chairman | Hideo Uchida | (Full-time) |
| Deputy chairman | Yoshimasa Togo | (Full-time) |
| Member | Ichiro Miyanaga | (Full-time) |
| Member | Toyozo Terajima | (Full-time) |
| " | Keiji Naito | (Part-time) |

A Nuclear Reactor Safety Experts Council (up to 60 part-time council members), which investigates and deliberates matters related to the safety of nuclear reactors, and a Nuclear Fuel Safety Experts Council, which investigates and deliberates matters related to the safety of nuclear fuel substances (up to 40 part-time members), are set up within the Nuclear Safety Commission.

In addition to these two councils, other experts groups have been established. (Table 2-3-1)

Table 2-3-1. Summary of Experts Groups within the Nuclear Safety Commission

| Name (Date Established) | Group Leader |
|---|---|
| Nuclear Reactor Safety Experts Council (4 October 1978) | Kazuo Sato |
| Nuclear Fuel Safety Experts Council (same as above) | Hiroichi Takashima |
| Nuclear Reactor Safety Standards Experts Group (1 November 1978) | Susumu Muranushi |
| Environmental Radioactivity Monitoring Central Assessment Experts Group (same as above) | Shinnobu Saito |
| Radioactive Waste Safety Regulations Experts Group (8 March 1984) | Masao Saai |
| Radioactive Waste Safety Standards Experts Group (12 May 1987) | Masao Saai |
| Radioactive Materials Transport Experts Group (6 December 1978) | Shigetomo Aoki |
| Nuclear Power Facilities Safety Research Experts Group (10 January 1979) | Tasaburo Yamada |
| Environmental Radiation Safety Research Experts Group (10 January 1979) | Yataro Tajima |
| Nuclear Reactor Vicinity Disaster Prevention Measures Experts Group (23 April 1979) | Masao Nozawa |
| Radio-Isotope Safety Regulations Experts Group (19 June 1979) | Shinnobu Sato |
| Nuclear Reactor Dismantling Safety Experts Group (20 December 1979) | Yoshio Ando |
| Emergency Technology Advisory Group (29 June 1979) | Hideo Uchida |
| Nuclear Power Facility Accident and Breakdown Analysis and Assessment Group (10 September 1987) | Hiroichi Fujiyaka |

**(3) State of Activities**

1) The Doublecheck System

Regarding safety inspections in connection with administrative agencies' authorization for the establishment/modification of nuclear reactor facilities and other related matters, the Nuclear Safety Commission conducts doublechecks, from an objective perspective, that are based on the latest scientific and technical knowledge. The commission's report submitted for FY 1988 listed 4 nuclear reactor facilities and 1 processing plant as new enlargement items; and 12 nuclear reactor facilities, one processing plant, and 2 reprocessing plants as modification items.

2) Drawing Up Inspection Guidelines

In implementing safety regulations for nuclear facilities, the Nuclear Safety Commission is now adopting and maintaining various guidelines and standards so that there will be uniform evaluations, based on objective and rational judgemental standards, of all regulations from administrative agencies. These types of guidelines, into which the latest scientific and technical knowledge is added in each successive revision, are now the subject of investigations and deliberations in groups such as the Nuclear Reactor Safety Standards Experts Group and the Nuclear Fuel Safety Standards Experts Group.

During FY 1988, the Nuclear Safety Commission came up with the "Guidelines for Evaluating Core Design in Electric-Power-Generating Pressurized Water Reactors" and "Thoughts on Evaluating the Safety of Advanced Thermal Converter Demonstration Reactors," and revised inspection guidelines on design safety and safety assessments. The commission also revised some related guidelines to reflect the new recommendations (Publication 26) of the ICRP (International Commission on Radiological Protection).

In connection with nuclear fuel facilities, the Nuclear Safety Commission revised some related guidelines to reflect ICRP recommendations in the same way as that for nuclear reactor facilities, and, at the same time, revised the "Safety Inspection Guidelines for Uranium Processing Facilities" to include the subject of uranium recovery.

In connection with radioactive waste management facilities, the commission came up with the report entitled "Thoughts on Safety Assessments of Waste Management Facilities" in March 1989.

3) Accident and Breakdown Inspections

The Nuclear Safety Commission carries out investigations and inspections in connection with reports it receives from concerned administrative agencies on the occurrence of accidents and breakdowns in nuclear power facilities. The commission also looks into matters pertaining to nuclear facilities in post-establishment-authorization stages when investigations are deemed necessary.

The numbers of accidents and breakdowns during FY 1988 were listed in a report based on the "Nuclear Reactor Regulation Law": 23 cases involving operational power-generating reactors; eight cases involving reactors used for test researh and reactors in the R&D stage; one case involving nuclear fuel facilities. In addition, the Nuclear Power Facility Accident and Breakdown Analysis Investigations Group, which was established in September 1987, is working towards further improvements and intensification of safety measures by conducting analyses and assessments of domestic and international accidents and breakdowns.

**Major Reports Submitted by the Nuclear Safety Commission during FY 1988**

| Name of Report | Date Submitted | Contents |
|---|---|---|
| Regarding Nuclear Reactor Establishment/Modifications at the Reactors of Chubu Electric Power Co.'s Hamaoka Nuclear Power Plant (Enlarging the No 4 Reactor and Modifying the No 1, No 2, and No 3 Reactors) | 14 July 1988 | Investigations and deliberations were conducted on the safety of the No 4 reactor in connection with conditions of the location, the safety of the design of the facilities, assessments of radioactivity levels during normal operations, etc. |
| Regarding Authorization for Nuclear Fuel Material Processing at the Japan Nuclear Fuel Industries Co.'s Rokkasho Plants | 21 July 1988 | Investigations and deliberations were conducted on the safety of the Rokkasho uranium-enrichment plant in connection with conditions of the location, the safety of the design of the facilities, assessments of radioactivity levels during normal operations, etc. |
| Regarding the Establishment of a Nuclear Reactor at the Hokuriku Electric Power Co.'s Noto Power Plant | 8 August 1988 | Investigations and deliberations were conducted on the safety of the reactor in connection with conditions of the location, the safety of the design of the facilities, assessments of radioactivity levels during normal operations, etc. |
| Regarding Nuclear Reactor Establishment/Modification at JAERI's Tokai Laboratory (STACY, Static Critical Assembly; TRACY, Transition Critical Assembly) | 22 September 1988 | Investigations deliberations were conducted on the safety of the critical test assembly in connection with conditions of the location, the safety of the design of the facilities, assessments of radioactivity levels during normal operations, etc. |
| Regarding Nuclear Reactor Establishment/Modifications at the Tohoku Electric Power Co.'s Onagawa Nuclear Power Plant (Enlarging the No 2 Reactor) | 9 February 1989 | Investigations deliberations were conducted on the safety of the critical test assembly in connection with conditions of the location, the safety of the design of the facilities, assessments of radioactivity levels during normal operations, etc. |
| Regarding Nuclear Reactor Establishment/Modifications at the Kansai Electric Power Co.'s Takahama Nuclear Power Plant (Modifying the No 3 and No 4 Reactors) | 9 March 1989 | Investigations and deliberations were conducted on design safety and assessments of radioactivity levels during normal operations in connection with the conversion of nuclear fuels to high-burnup fuels |

4) Implementing Public Hearings

In order to gain the understanding and the trust of the Japanese people with regard to the safety of nuclear power, we must not only enforce stringent doublechecking and ensure safety, but must also allow the opinions of the Japanese people to have an influence upon nuclear safety administration. To that end, in attending to the tasks of studies and deliberations related to the establishment of nuclear power generating plants, the Nuclear Safety Commission is implementing public hearings in order to listen to the questions and opinions of local residents on the safety characteristics of nuclear power facilities in their areas. Until FY 1988, 16 public hearings were held on the establishment of and modifications to nuclear reactors at the Tohoku Electric Power Co.'s Onagawa Nuclear Power Plant. 5) Holding the "Nuclear Power Safety Gathering"

From the perspective of contributing to further improvements in nuclear power safety, the "Nuclear Safety Gathering" was held on 19 October 1988 in Tokyo, sponsored by the Nuclear Safety Commission. Because 1988 was the tenth anniversary of the commisssion's inception, this was an oportunity to review past nuclear safety ensurance activities and to examine outlooks for the future. In this "gathering," there were lively discussions amongst approximately 500 nuclear-power-related personnel and individuals active in local public groups; those invited included Mr Denton, the bureau-chief of the U.S. NRC (Nuclear Regulatory Commission), and Mr Rosen, the deputy-secretary-general of the IAEA (International Atomic Energy Association).

(From the Nuclear Safety Investigations Office of the Nuclear Safety Division of the Nuclear Safety Bureau)

## Chapter 4. Radiation Council

### (1) General Situation

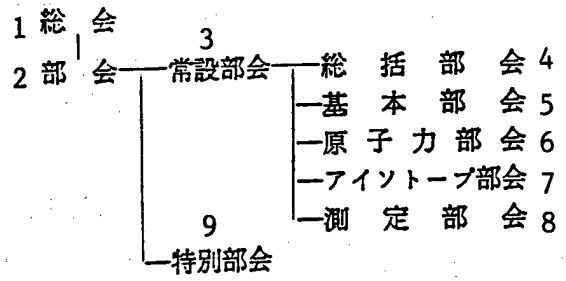
The Radiation Council is an advisory organ within the Science and Technology Agency that was established in accordance with the "Law on Technical Standards for Preventing Radiation Damages". Its purpose is to determine consistent technical standards for preventing radiation damages.

The council submits reports in response to inquiries from the heads of concerned administrative organizations and offers its opinions as the need arises.

### (2) Organization

The council is composed of up to 30 members, but experts are also organized to investigate specialized matters, and a governor is there to advise members. The divisions, among which the council's several administrative affairs are divided, are normally composed of individuals from experts groups and regular committee members. The divisions report the results of their detailed research studies on matters that had been submitted by the general assembly.

**Organizational Chart**




Key:—1. General Assembly—2. Divisions—3. Permanent Division—4. General Division—5. Base Division—6. Atomic Energy Division—7. Isotope Division—8. Measurements Division

### (3) State of Activities

On 3 August 1988 the council held deliberations on the Prime Minister's inquiry entitled "On Technical Standards for Preventing Radiation Damage in connection with Regulating the Management of Nuclear Fuel Substance and Nuclear Fuel Substance-Contaminated Wastes," and submitted a report on 7 December 1988.

(From the Nuclear Safety Division of the Nuclear Safety Division Bureau)

## Chapter 5. Space Development Commission

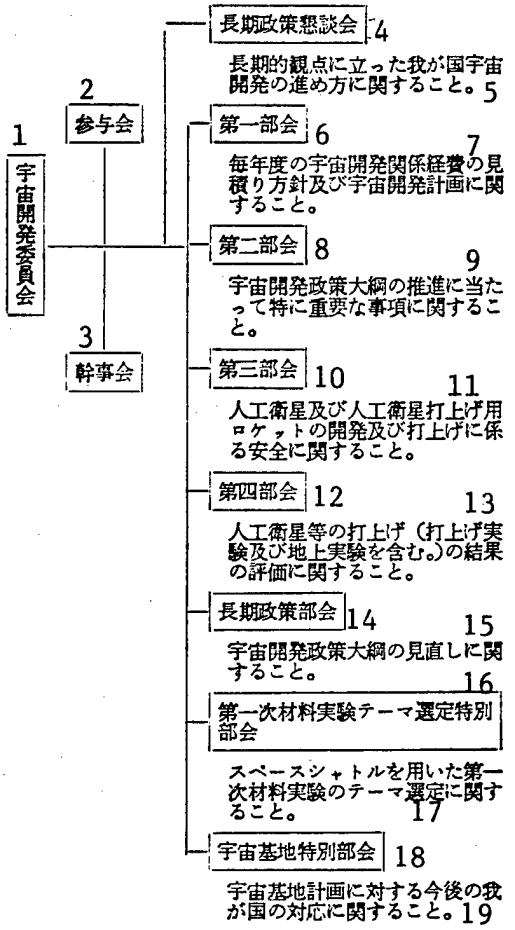
### (1) General Situation

The Space Development Commission was established within the Prime Minister's Office on 2 May 1988 for the purpose of assisting in the democratic management of space development and in the comprehensive and systematic promotion of national space development policies.

The commission plans, deliberates, and makes decisions on the issues mentioned below, and expresses its opinions on its decisions to the Prime Minister. The Prime Minister must give these serious consideration.

1) Important space-development-policy-related matters.
2) Important matters that are a part of the comprehensive coordination of space-development-related affairs within concerned administrative organizations.
3) Matters relating to estimating space-development-related costs in concerned administrative organizations.
4) Matters in connection with the general outline on training and education for space-development researchers and technicians (excluding professors' research in universities).
5) Other important space development matters not mentioned above.

**Organizational Chart**




Key:—1. Space Development Commission—2. Consultants—3. Governors—4. Long-Term Policy Discussion Group—5. Ways in which Japan's space development will proceed, based on a long-term perspective—6. First Division—7. Yearly space development programs and guidelines on estimating yearly space-development-related costs—8. Second Division—9. Particular important matters encountered in the promotion of Space Development Policy Outline—10. Third Division—11. The development of satellites and satellite-launching rockets, and launch safety.—12. Fourth Division—13. Evaluations of satellite-launch results(including launch experiments and ground experiments)—14. Long-Term Policy Division—15. Revisions to the Space Development Policy Outline—16. First Material Experiment Theme Selection Special Division —17. Selecting themes for first material experiments using the Space Shuttle—18. Space Base Special Division—19. Matters related to how Japan will deal with space-base programs in the future

### (2) Organization

The Space Development Commission is composed of two full-time members and two part-time members and is headed by the director-general of the Science and Technology Agency.

| Space Development Commission (March 1989) | | |
|---|---|---|
| Chairman | Shigeichi Miyazaki | (Director-general of the Science and Technology Agency) |
| Deputy chairman (full-time) | Nariaki Saito | (Professor emeritus at Tokyo University) |
| Member(full-time) | Akinori Kurawa | (Managing director of the Advanced Technology Development Corp.) |
| " (part-time) | Katsumi Soyama | (President of FM Japan Co.) |
| " (part-time) | Toshio Tajima | (President of Fuji Heavy Industries, Ltd.) |

In addition, governors, who advise members, the head of the commission, and consultants on important affairs of the commission, and experts groups, who investigate and deliberate specialized matters, are set up within the Space Development Commission. Figure 2-5-1 shows the current, March 1989, organization of the commission.

### (3) State of Activities

The major items deliberated by the Space Development Commission during FY 1988 are as follows.

1) Space Development Policy Outline Revisions

The Long-Term Policy Division was established within the Space Development Commission in December 1987 to assist in revising the "Space Development Policy Outline," Japan's long-term guidelines on space development. This division conducted investigations and deliberations to determine necessary revisions to the outline.

2) FY 1989 Space-Development-Related Cost Estimates

The Space Development Commission conducted investigations and deliberations on FY 1989 space-development-related costs and concluded its estimates on 26 August 1988.

3) Space Development Program Revisions

The commission concluded its revisions to space development programs on 15 March 1989.

4) Safety Measures for Launching Satellites and Satellite-Launching Rockets

On 16 November 1988, the Third Division submitted a report of its investigations and deliberations on safety measures in connection with the launch of the No 4 M-3SII rocket to the Space Development Commission.

5) Evaluations of the Results of Launches of Satellites and Satellite-Launching Rockets

The Fourth Division conducted investigations and deliberations concerning the evaluation of launch results of the No 3-a communications satellite (CS-3a) and the operating conditions of the telemetry encoders of the No 2-b broadcast satellite (BS-2b), and submitted a report of its findings on 8 June 1988 to the Space Development Commission. On 1 March 1989, the Fourth Division submitted a report of its findings from investigations and deliberations concerning the evaluation of launch results of the No 3-b communications satellite (CS-3b) and the operating conditions of the telemetry encoders of the No 2-b broadcast satellite (BS-2b).

(From the Policy Division of the Research and Development Bureau)

## Chapter 6. Marine Development Council

### (1) General Situation

The Marine Development Council, a reorganization of the Marine Science and Technology Council in response to an inquiry from the Prime Minister, was established within the Prime Minister's Office during July 1971 for the purpose of investigating basic and comprehensive matters in connection with the development of the oceans.

### (2) Organization

The council is composed of up to 20 individuals under whom experts and governors are organized.

| Marine Development Council Name Register (November 1989) | | |
|---|---|---|
| **Chairman** | **Kinoyoshi Nasu** | **Professor at the University of the Air** |
| Member | Bunji Ikejiri | Chairman of the National Federation of Fisheries Cooperative Associations |
| " | Masamitsu Ito | NHK (Japan Broadcasting Corp.) Commentator |
| " | Mamoru Uchida | President of Nihon Taikaiji Kyokai |
| " | Toshihiku Oba | Consultant to the Fishing Industry Association Group |
| " | Motokazau Ogiso | Professor of Law at Tokai University |
| " | Hiroshi Kamiya | Chairman of the board of directors of the Nippon Telecommunications Satellite Co. |
| " | Hideo Furukawa | Professor at the Science and Engineering Department of Waseda University |

**Marine Development Council Name Register (November 1989) (Continued)**

| Chairman | Kinoyoshi Nasu | Professor at the University of the Air |
|---|---|---|
| " | Toshimitsu Anda | Professor at the Engineering Department of Yokohama National University |
| " | Kazuo Sugiyama | Chairman of the Tokyo Bay Local Development Committee, Japan Project Industries Association |
| " | Hirohito Seno | Managing director of Shipping Services Public Group |
| " | Hideo Takabayashi | Professor at the Law Department of Kyushu University |
| " | Kazuko Toyama | Professor at Rissho University Junior College |
| " | Takeshi Nagano | Chairman of the board of directors of Mitsubushi Metals Corp. |
| " | Yoshinaga Nimoto | Director of the Ocean Research Institute at Tokyo University |
| " | Yoshikazu Hirakawa | Professor emeritus at Tokyo University |
| " | Reijiro Hirano | Professor in Fisheries Science Dept at Hokuri University |
| " | Noboyuki Makimura | Managing Director of the Marine Science and Technology Center |
| " | Kunihiko Matsuo | Managing director of the Japan National Oil Corp. |

### (3) State of Activities

1) In order to get an accurate grasp on domestic needs corresponding to new trends in the international order of the seas, which centers on the U.N. Conference on the Law of the Seas, and to establish concrete promotional policies on marine development, the Marine Development Council put together two reports, on 15 August 1979 and on 22 January 1980, in response to the Prime Minister's inquiry from 15 August 1979, "Regarding Basic Ideas and Promotional Policies for Long-Term Marine Development."

2) Furthermore, in order to cope with changing international circumstances, beginning with the adoption of the U.N. Convention on the Law of the Seas, and to assist in studying ways by which to promote Japan's marine development, the International Issues Group drafted a report of their investigations of trends in overseas marine development. The report entitled "The Promotion of Orderly International Cooperation in Marine Development" was published in November 1974.

3) For the purpose of clarifying the role of 21st-century-oriented marine development and establishing policies, the Marine Development Council is deliberating its response to the inquiry submitted by the Prime Minister on 3 February 1989 entitled Regarding Basic Ideas and Promotional Policies for Long-Term Marine Development."

(From the Marine Development Division of the Research and Development Bureau)

## Chapter 7. Technical Fellows Council

### (1) General Situation

The Technical Fellows Council, whose establishment was stipulated in the Technical Fellows Law (Law No 25 in 1983), deliberates the following: 1) important matters in connection with the Technical Fellows System; 2) technical fellows' and candidate technical fellows' registration cancellations and title-use suspensions; 3) recommendations of the Test Committee.

A general division and a test division are organized within the Technical Fellows Council.

### (2) Organization

In addition to council members, the council also has expert members who investigate specialized matters.

The Prime Minister appoints council members from among those individuals who are well acquainted with matters pertaining to the Technical Fellows System. The director-general of the Science and Technology Agency selects expert members who are men of learning and experience or who are staff members of related administrative organizations.

1) Technical Fellows Council

Currently, in March 1989, 15 individuals of learning and experience make up the council, which may have up to 15 members.

**Technical Fellows Council Members (March 1989)**

| Commission chairman | Katsushige Mita | Representative president of Hitachi, Ltd. |
|---|---|---|
| | Kazutomo Imabori | Managing director of Mitsubishi Chemical Co.'s Life Sciences Research Institute |
| | Michiro Kawada | Consultant to Suzuki Motor Co. |
| | Shigeo Kishi | Vice-president of the Japan International Cooperation Agency |

| Technical Fellows Council Members (March 1989) (Continued) | | |
|---|---|---|
| | Masaharu Kuramoto | Managing director of the Japan Science Foundation |
| | Kosaka Tadashi | Director of the Land Development Technology Research Center |
| | Tsukasa Sakai | Managing director of the JGC Corp. |
| | Juhei Sakurai | Consultant to the Japan Fodder Crops and Seeds Association |
| | Koji Sasaki | Former editorial staff member of the Nihon Keizai Shimbun |
| | Eiji Sugita | Consultant to the Japan Agricultural Public Works General Research Institute |
| | Hideo Narita | Managing director of the Japan Technical Fellows Association |
| | Yasuo Hisata | Vice-president of the Nippon Tetrapod Co. |
| | Tsuneo Mori | Representative vice-president of the Nippon Koei Co. |
| | Hiroichi Morishima | Director of the University of the Air Campus |
| | Hiroyoshi Yokoyama | Consultant to the Tobishima Construction Co. |

2) General Division

This group deliberates matters concerning technical fellows and candidate technical fellows and the healthy development of the Technical Fellows Council, and matters pertaining to the Japan Technical Fellows Association.

This division is made up of 19 council members and 10 experts (men of learning and experience).

3) Test Division

This group discusses methods for testing technical fellows and candidate technical fellows, and the implementation of those methods; qualifications for examination eligibility; the recommendations of technical fellows for membership in the Test Division; and the quotas for their groups.

This division is made up of 9 council members and 37 experts (29 men of learning and experience and 8 staff members of concerned administrative organizations).

### (3) State of Activities

In order to contribute to the development of the Technical Fellows System, the Technical Fellows Council conducted studies and discussions on problems with the system and on policies for putting technical fellows to practical use, and submitted a report entitled "On Improving the Technical Fellows System" to the director-general of the Science and Technology Agency in July 1982.

The major contents of the report dealt with: 1) newly establishing a Candidate Technical Fellows System, 2) facilitating the practical application of technical fellows, 3) simplifying the management of the systems, and 4) revising technical categories.

After this report was received, the Technical Fellows Law was amended in April 1983. The principal revisions were: 1) from the viewpoint of activating the Technical Fellows System, establishing the "Candidate Technical Fellows System"; 2) from the viewpoint of simplifying administration, allowing individuals designated by the director-general of the Science and Technology Agency to oversee the implementation of test and registration-related matters.

Incidentally, the incorporated Japan Technical Fellows Association was designated as the both the test and registration organizations on 1 February 1984.

All but a part of the revised law came into effect on 1 April 1984.

Starting in March 1987, the Technical Fellows Council conducted studies and discussions on model subjects and technical categories for Technical Fellows examinations, and submitted a report entitled "On Improving the Technical Fellows System" to the director-general of the Science and Technology Agency in October 1988.

The major contents of the report dealt with: 1) establishing a biological engineering category; 2) changing the name of the "Aircraft Category" to the "Aerospace Category," the "Electricity Category" to the "Electricity and Electronics Category," and the "Mining Category" to the "Resources Engineering Category"; and 3) revising certain examination subjects for each department.

After this report was received, some of the regulations for enforcing the Technical Fellows Law were amended in December 1988 and became effective on 1 February 1989.

(From the Science and Technology Information Division of the Science and Technology Promotion Bureau)

## Chapter 8. Council for Aeronautics, Electronics and Other Advanced Technologies

### (1) General Situation

The Council for Aeronautics, Electronics and Other Advanced Technologies was established in May 1978 in accordance with the "Law on Council Reorganization." The purposes of the council are, in connection with aeronautics, electronics, and all other technologies, to

deliberate important matters relating to technology that is required for comprehensive test research, efforts which necessitate cooperation amongst many departments; to submit reports on these matters in response to inquiries from the director-general of the Science and Technology Agency; and, as the need arises, to make recommendations to the director-general of the agency.

**(2) Organization**

The council is composed of up to 25 individuals of learning and experience who are appointed by the director-general of the Science and Technology Agency. Currently, at the end of April 1989, the council consists of the following 24 members.

**Members of the Council for Aeronautics, Electronics and Other Advanced Technologies**

| | | |
|---|---|---|
| Chairman | Kunimitsu Umezawa | Managing director of the Yoshida Foundation for Science and Technology |
| Members | Akira Higashi | Professor at the Tokyo Metropolitan Institute of Technology |
| | Tsunetaro Iida | President of Mitsubishi Heavy Industries, Ltd. |
| | Toshimitsu Ito | Nippon Hoso Kyokai commentator |
| | Shozo Iwasaki | Executive director of Nippon Telegraph and Telephone Co. |
| | Akira Otani | Director of the National Institute of Health |
| | Michiro Kawada | Consultant to Suzuki Motor Co. |
| | Kazutake Kora | Executive director of the Society for the Encouragement of Research in High-Energy Accelerator Science |
| | Riyako Godai | Commentator |
| | Masaru Goto | Director of the Research and Development Corporation of Japan |
| | Takashi Kobayashi | Highest consultant to Matsushita Electric Works, Ltd. |
| | Shigeo Kobayashi | Professor at the Tokyo Metropolitan Institute of Technology |
| | Toshinori Sakata | Director of the Tokai University Information Technology Center |
| | Yasunori Sagoda | Vice-president of the NTT Urban Development Co. |
| | Koichi Shimoda | Professor at Keio University |
| | Shigeji Suehiro | Advisor to the Japan Meteorological Association |
| | Toshinoru Takagi | Vice-president of the Ion Engineering Center |
| | Takashi Takeda | Chairman of the Ministry of Transport's Aircraft Accident Investigation Committee |
| | Kinoyoshi Nasu | Professor at the University of the Air |
| | Osamu Hayaishi | Director of the Osaka Bio-Science Research Institute |
| | Teruni Matsui | Consultant to the Japan Forestry Association |
| | Katsura Morita | Executive director of Takeda Chemical Industries, Ltd. |
| | Masanari Yamano | Representative chairman of the A.S.T. Co. |
| | Zenichi Yoshida | Professor at Kyoto University |

**(3) State of Activities**

During FY 1988, the council submitted a report in response to Inquiry No 12, "Regarding the Promotion of Comprehensive Research and Development in Human Genetics Analysis," (June 1988) and also put together a report of from its earth S&T division (17 October 1988). The council continued discussing Inquiry No 13, "Regarding the Promotion of Comprehensive Research and Development in the Creation of New Substances and Materials That Have the Capacity to Exhibit Functions and Respond Intelligently to Environmental Conditions" (July 1987).

(From the Policy Division of the Research and Development Bureau)

**Reports Submitted by the Council for Aeronautics, Electronics and Other Advanced Technologies during FY 1988**

| Title | Date of Report | Contents |
|---|---|---|
| Inquiry No 12 | | |
| Regarding Promotional Policies for Comprehensive Research and Development in Human Genetics Analysis | 27 June 1988 | This report is a compilation of surveys on the significance of research on human genetics analysis, a field that is gaining international attention; the effects and results obtained by promoting this research; international and domestic standards for this research; and basic thoughts on the present and future promotion of human genetic analysis. |
| Earth Science and Technology Division Report | 17 October 1988 | This report compiles information on the importance of comprehensive promotion of earth S&T research studies. |

## Chapter 9. Resources Research Council

### (1) General Situation

The Resources Research Council investigates and deliberates important matters in connection with the utilization of natural resources, submits reports on these matters in response to inquiries from the director-general of the Science and Technology Agency, and, as the need arises, submits reports and recommendations to the director-general. A record of these achievements is shown in Table 2-9-1 [not reproduced]. From the time of its inauguration (December 1947) to the present (late March 1989), the Resources Research Council has published one major report, 48 recommendations, 134 other reports, and 184 data publications. The contents of the council's investigations are reflected in all areas of resource-related policy-making.

### (2) Organization

The council is composed of up to 20 individuals and additional experts groups who investigate specialized matters.

Members of the council and its experts groups are appointed from among learned and experienced individuals and from among personnel of related administrative organizations.

**Members of the Resources Research Council (March 1989)**

| | | |
|---|---|---|
| Chairman | Yoshimitsu Takeyasu | Member of the Council for Science and Technology |
| Members | Tomoei Akiyama | Managing director of the Forest Development Public Corp. |
| " | Shinichiro Asai | Managing director of the Metropolitan Expressway Public Corp. |
| " | Shigeru Ito | Professor at Tokyo University |
| " | Tsunemasa Imaizumi | Professor emeritus at Tokyo University |
| " | Kazutomo Imabori | Managing director of Mitsubishi Chemical Co.'s Life Sciences Research Institute |
| " | Yoichi Kaya | Professor at Tokyo University |
| " | Susumu Kinoshita | Vice-president of the Japan Iron and Steel Association |
| " | Akiko Sano | Professor at Keio University |
| " | Hirotoshi Samejima | Managing director of Kyowa Medics Co. |
| " | Hiroshi Takahashi | Professor at Shibaura Institute of Technology |
| " | Masashi Nagaoka | Former NHK commentator |
| " | Takashi Hibiya | Professor emeritus at Tokyo University |
| " | Noboru Makino | Managing director of Mitsubishi Comprehensive Research Ltd. |
| " | Minoru Matsuoka | Managing director of the New Energy Development Organization |
| " | Yoshinobu Matsumoto | Representative director of Japan Coal and Oil, Ltd. |
| " | Ryozo Matsuyama | Chairman of the National Agricultural Improvement and Dissemination Association |
| " | Hitoshi Miyazaki | Managing director of the Arabian Oil Co. |
| " | Taro Yamada | Former chairman of the House of Representative's Special Committee on Measures for Promoting Science and Technology |
| | Masanari Yamano | Representative chairman of the A.S.T. Co. |

**(3) State of Activities**

The council published three reports during FY 1988.

1) "Investigative Report on the Significance and Advanced Utilization of Green Resources" (Information Report No 109, April 1988). In recent years in Japan, there is a heightening consciousness that seeks after peace of mind and spiritual abundance, and intense concern over the civilized utilization of Nature and greenery has appeared. The current state of affairs is such that the practical utilization of Nature and greenery and its appropriate management is inadequate and still ineffective, and that the value of Nature and greenery is not sufficiently brought out. This report examines the significance of green resources and policies for their advanced utilization, where "green resources" are defined as the entirety of living things, especially plant life, and the lands, waters, and spaces in which those living things dwell.

2) "Investigative Report on Human Development and the Environment During Infancy" (Information Report No 110, September 1988). In the formation of human intelligence, the ideal kind of environment in which to raise infants is now, more than ever, an extremely important issue. Although modern research on the mutual interaction between mother and child has been enlightening, the environment in which infants are raised has been undergoing dramatic transformations due to social advances for women, the nuclearization of the family, the tendency towards smaller families, and changes in the information environment. Because cases of child abuse and other such psychological causes of illness in infants have been emerging in large numbers in developed countries, we published this report, which consolidates scientific information on the development of human intelligence during infancy and examines policies that aim for the development of good environments in which to rear children.

3) "Investigative Report on 21st Century Civilization and Resource Problems" (Information Report No 111, September 1988). On the brink of the 21st century, the emergence of a new civilization is foreseen as inevitable. Since the dawn of history, the emergence of a new civilization, like that which is seen in the agricultural and industrial revolutions, expands the concept of "resources backed by innovative technology" and deals with the problem of how to renew resources. In order to work towards the creation of new resources at the end of the 20th century and towards more effective utilization of resources, it is important to look at 21st century society from various perspectives. To that end, this report looks at the various fluctuations in society over the next 10 years and examines thoughts on resources and their utilization.

(From the Resources Office of the Policy Division of the Science and Technology Policy Bureau)

## Part III. Summary of Affiliated Research Institutes

### Chapter 1. National Aerospace Laboratory

**(1) General Situation**

The National Aerospace Laboratory was established as the National Aviation Technology Research Laboratory, an affiliated organization of the Prime Minister's Office, in July 1955. It became affiliated with the Science and Technology Agency when the agency was inaugurated in May 1956, and its name was changed to the National Aerospace Laboratory in April 1963.

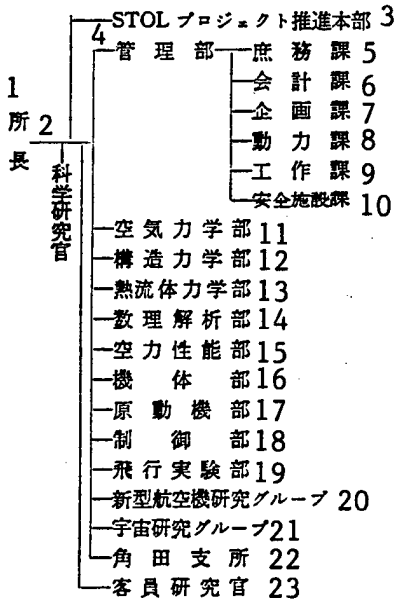
In accordance with ideas put forth in reports from organizations such as the Space Development Commission and the Council for Aeronautics, Electronics and Other Advanced Technologies, the laboratory conducts test research and maintains the facilities and equipment needed for that research; the laboratory also plans long-term programs.

During FY 1988, the laboratory conducted research in the following fields: 1) STOL aircraft, 2) innovative aerospace transport technology, 3) space transport systems, 4) space environment utilization and satellite systems, 5) numerical simulation, and 6) technology applications in non-aerospace fields.

In particular, the laboratory is aggressively pushing "Fan-Jet STOL Aircraft Research and Development" as high-priority research within the overall organization.

### (2) Organization

**Figure 3-1-1. Organizational Chart**




Key:—1. Director—2. Scientific Research Officials—3. STOL Project Promotion Headquarters—4. Administrative Section—5. General Affairs Department—6. Accounting Department—7. Planning Department—8. Power Department—9. Construction Department—10. Facilities Safety Department—11. Aerodynamics Division—12. Structural Dynamics Division—13. Heat Flow Body Dynamics Division—14. Mathematical Analysis Division—15. Aerodynamic Performance Division—16. Airframe Division—17. Engine Division—18. Control Division—19. Flight Experiments Division—20. Advanced Aircraft Research Group—21. Space Research Group—22. Kakuda Branch Office—23. Guest Research Officials

### (3) Budget and Personnel

**Table 3-1-1. FY 1988 Budget (Unit: ¥1000)**

| Item | Budget Amount |
|---|---|
| Personnel expenditures | 2,964,336 |
| Ordinary business expenditures | 1,307,301 |
| Commissioned research expenditures | 10,250 |
| STOL R&D expenditures | 2,257,958 |
| Aerospace S&T special research expenditures | (debit) 147,160 |
| | 620,152 |
| Facilities and equipment maintenance expenditures | (debit) 755,660 |
| | 2,730,486 |
| Facilities expenditures | (debit) 141,042 |
| | 108,724 |
| Total | (debit) 1,043,862 |
| | 9,999,367 |

**Table 3-1-2. FY 1988 Personnel (Number of people)**

| Section | Number |
|---|---|
| Appointed positions | 2 |
| Research positions | 336 |
| Administrative positions (1) | 90 |
| Administrative positions (2) | 16 |
| Expert administrative positions | 4 |
| Total | 448 |

The budget is approximately ¥10 billion (including operating costs for the facilities), as shown in Table 3-1-1. In addition, ¥23.656 million from MITI for Large-Type Energy-Saving Technology Development (expenditure authorization), ¥195.687 million from the Coordination Funds for Promoting Science and Technology, ¥38.6 million from the Science and Technology Promotion Funds, ¥31.722 million from the Environmental Agency's budget package for pollution prevention research in national organizations, and ¥10.448 million from Marine Development and Research Studies Promotion Funds were available.

As for personnel, two new staff members were added and four individuals left, for a total of 448 individuals, which is an overall decrease of two in comparison with the previous year.

### (4) Summary of Operations

The content of major research efforts, by field, is as follows.

1) STOL Aircraft Research

Fan-Jet STOL Aircraft R&D (Special Research)

Development of the experimental "Asuka" low-noise STOL aircraft and its flight experiments are the core of this research, the objective of which is to establish various new technologies, such as USB-formula (upper surface blowing) high-lift technology and computer flight control technology, that are associated with the short-takeoff-and-landing capabilities and low-noise characteristics of the fan-jet STOL aircraft.

A. Flight Experiments

As the overall assessment of the "Asuka" experimental aircraft during FY 1988, the laboratory conducted flight tests, which verified the effectiveness of various kinds of new technologies, until the original objectives were reached.

B. Research on a STOL-Aircraft Database

Using the results obtained from "Asuka" flight experiments as the core data, the laboratory collected data on relevant technology and pushed forward with both software and hardware design for a database that will contribute to future aircraft development.

C. NAL-NASA Joint Research

These efforts involved preparations for high-speed wind tunnel testing of the "Asuka" model at NASA's Ames Research Institute and flight evaluation tests of the "Asuka" with NASA test pilots. 2) Innovative Aerospace Transport Technology Research

The laboratory is working towards establishing innovative aerospace transport technology for the 21st century through its R&D efforts in advanced elemental technologies. These technologies will become the nucleus of innovative aircraft that will enable space development activities to evolve freely, space vehicles and hypersonic aircraft to handle the needs for super-high-speed transport, and highly efficient transport with the capacity for heavy loads and long distances.

Research on Elemental Technologies for Innovative Aerospace Transport (Special Research)

A. Research on Aerodynamics Technology
- Research on laminar flow control technology
- Research on new configuration aerodynamics technology
- Experimentation and numerical simulation in connection with the super-high-speed aerodynamical characteristics of space vehicles
- Research on the aerodynamical performance of space vehicles
- Research on the low-speed characteristics of space vehicles

B. Research on New Composite Materials Structural Technology
- Research on the strength characteristics of structural elements made of thermoplastic composite materials
- Research on aeroelastic tailoring
- Research on the heat and strength characteristics of super-heat-resistant and heat-preventative materials
- Basic research on materials and structures in super-high-temperature environments

C. Research on Flight Control Technology
- Research on the active control of aeroelastic systems
- Research on intelligent flight control technology
- Research on fly-by-light control technology
- Research on innovative aircraft/space vehicle flight systems using VSRA (variable stability response assembly)

D. Research on Propulsion Systems Technology
- Research on super-high bypass ratio variable configuration engines
- Research on air-breathing engines for use in high-speed aircraft
- Ram/scram jet engine research

E. Research on Space Vehicle Systems
- Research on system concepts for space transport vehicles Research on the systemization of elemental technologies

Research on a Winged Space Vehicle Planned for Launch from an H-II Rocket (Joint Research with the National Space Development Agency of Japan)
- Research on aerodynamics technology
- Research on thermostructural technology
- Research on guidance and control technology

Research on High-Speed Turbo-Prop Elemental Technology (Special Joint Government-Private Research)

In addition to that mentioned above, project research and research based on the Coordination Funds for Promoting Science and Technology Priority Fundamental Research System is included.

3) Research on Space Transport Systems

(Special Research)

Research on Liquid Oxygen/Liquid Hydrogen Rocket Engine Elements

The National Aerospace Laboratory is conducting research on the elemental technology needed for the development of the LE-7 engine, which they planned to use in the first stage of the H-II rocket.

During FY 1988, research on turbo-pump systems involved strength tests of inducers and research on the hydrogen-embrittlement characteristics of high-pressure turbine blades.

Research on materials technology was aimed at increasing the performance of combustion chamber systems so that can they can withstand the highest pressures and will last longer.

(Ordinary Research)

- Research on two-liquid-formula high-performance engines
- Research on future propulsion systems
- Thermodynamic and aerodynamic research on recovery technology
- Research on liquid rocket engine systems
- Research on rendezvous and docking techniques
- Research on solid rocket fuels

4) Research on Space Environment Utilization And Satellite Systems

(Special Research)

Research on Basic Satellite Technology

In order to improve the performance of satellites so that they can cope with increasingly diversified and sophisticated missions in the future, and to further domestic production that is based on independent technology, the laboratory will strive to establish the various kinds of common and fundamental basic technologies that make up satellite systems.

During FY 1988, these efforts involved research on bearings for space use, flexible-structure satellite control, and xenon ion engines.

(Special Research)

Research on Experimental Space Environment Utilization Technology

The laboratory will strive to establish the space utilization technology with which to effectively promote space environment utilization, activities that will become increasingly diversified and sophisticated in the future. Research conducted during FY 1988 included extended-type laboratory tables, water and gas circulation apparatus, taser/boomerangs, applications of artificial intelligence, and converging-type solar thermal power generation systems.

(Ordinary Research)

Research on manned support technology
Research on fundamental space utilization technology
Research on remote sensing technology
Research on solar heat propulsion systems

5) Research on Numerical Simulation Technology

(Ordinary Research)

Research on numerical aerodynamics simulation technology
Research on numerical simulation technology for propulsion system aerodynamics
Research on the numerical simulation of structural strength
Research on high-resolution computation methods
Research on system technology for numerical simulation and other systems
Research on artificial intelligence technology for use in aerospace

6) Research on Applications of Aerospace Technology in Other Fields

(Research based on MITI's Large-Type Energy-Saving Technology Research and Development)

Ceramic gas turbine R&D

(Research based on the Coordination Funds for Promoting Science and Technology)

Research on the basic technology with which to develop functionally gradient materials for the purpose of mitigating thermal stress

International cooperative research on the elucidation of physical, chemical, and biological phenomena in microgravity environments

International joint research on technology for testing and evaluating new materials

(Research based on funds from the Environmental Agency's budget package for pollution prevention research in national organizations)

Research on reducing aircraft noise that is due to aerodynamical interference

Research on low-pollution catalytic combustion for gas turbines

In addition to the aforementioned, as strengthened cooperation among industry, universities, and the government, there were 95 cases of joint research between the National Aerospace Laboratory and groups such as National Space Development Agency of Japan, 14 cases of equipment loans, and 18 cases of commissioned testing. The laboratory was also involved in international joint research and research cooperation.

Regarding research facilities and equipment, the laboratory continued work from the previous year on the special refurbishment of the transonic and hypersonic wind tunnels, which were considerably worn out, and began maintenance work on the composite material structural testing facilities.

## Chapter 2. National Research Institute for Metals

### (1) General Situation

The National Research Institute for Metals was established in July 1956.

Since its inauguration, the institute has been conducting basic and comprehensive research in all fields that Japan requires in connection with metals technology, and, with the many fruits of its efforts, has come to play a great role in the development of Japan's industries.

In September 1987, the institute decided upon its 3rd long-term program, which took a hard look at future models for the institute, and underwent an overall reorganization in April 1988.

During FY 1988, the institute promoted the following research under the new system: 1) research on the development of new materials, with priority given to yet unopened areas; 2) two-pronged research to establish materials reliability, for promoting basic and pioneering research that will bring forth seeds and for coping as a

core organization involved in domestic and international materials research, a) basic and fundamental research on new superconductive materials as a core organization in the Multi-Core Superconductor Research Project, a project whose purpose is to make inroads in the practical application of new superconductive materials; b) research on the creation of revolutionary new materials that are sought after in various technical fields; c) the development of materials for fast breeder reactors and nuclear fusion reactors, and research on the safety of metals that are used in light water reactors; d) as high-priority items, research on materials evaluations, for ensured materials reliability, and data sheet publications; also, test research that involves 56 project themes, 49 ordinary research themes, and 2 research study themes. In addition to these, the institute conducted joint research efforts with outside Japanese and overseas organizations, commissioned research work, and commissioned creep testing.

### (2) Organization

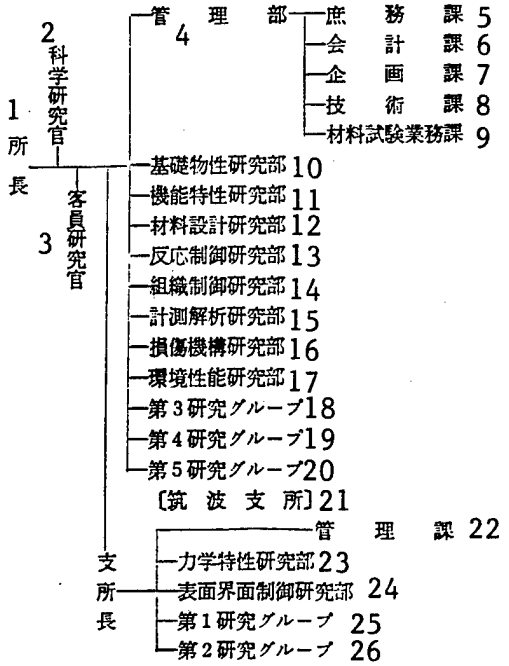
### (3) Budget and Personnel

**Table 3-2-1. FY 1988 Budget (Unit: ¥1000)**

| Item | Budget Amount |
|---|---|
| Personnel expenditures | 2,829,881 |
| Ordinary business expenditures | 698,349 |
| Commissioned research expenditures | 5,121 |
| Special research | 153,250 |
| Facilities and equipment maintenance expenditures | 96,389 |
| Materials testing | 41,974 |
| Tsukuba facilities promotion | 241,565 |
| New superconductive materials R&D | (debit)1,216,00<br>1,009,388 |
| Facilities expenditures | 97,835 |
| Total | (debit)1,216,000<br>5,174,022 |

As shown in Table 3-2-1, the budget was approximately ¥5.2 billion (including operating costs for the facilities), an increase of ¥700 million over the previous year. In addition, ¥243.588 million from the National Organizations' Atomic Energy Test Research Funds, ¥26.851 million from the National Organizations' Pollution Prevention Test Research Funds (transition), ¥46.171 million from the Mining and Manufacturing Industry Technology Promotion Funds (expenditure authorization), ¥365.875 million from the Coordination Funds for Promoting Science and Technology, and ¥46 million from the Science and Technology Promotion Funds were available.

**Figure 3-2-1. Organizational Chart**




Key:—1. Director—2. Scientific Research Officials—3. Guest Research Officials—4. Administrative Department—5. General Affairs Department—6. Accounting Department—7. Planning Department—8. Technology Department—9. Metal Testing Department—10. Basic Physical Properties Research Department—11. Functional Characteristics Research Department—12. Materials Design Research Department—13. Reaction Control Research Department—14. Composition Control Research Department—15. Measurement and Analysis Research Department—16. Failure Mechanism Research Department—17. Environmental Performance Research Department—18. Third Research Group—19. Fourth Research Group—20. Fifth Research Group—21. [Tsukuba Branch Laboratory]—22. Administrative Department—23. Dynamic Characteristics Research Department—24. Surface Interface Control Research Department—25. First Research Group—26. Second Research Group

**Table 3-2-2. FY 1988 Personnel (Number of people)**

| Section | Number |
|---|---|
| Appointed positions | 2 |
| Research positions | 333 |
| Administrative positions (1) | 79 |
| Administrative positions (2) | 23 |
| Total | 437 |

As for personnel, there were 437 staff members, as shown in Table 3-2-2.

**(4) Contents of Operations**

During FY 1988, our research was centered on the following: 13 new superconducting materials R&D themes, four special research themes, 10 nuclear power research themes, 17 themes on research involving the Coordination Funds for Promoting Science and Technology (comprehensive research, eight themes; priority basic research, six themes; individual important international joint research, two themes; emergency commissioned research, one theme), one specific joint government-private research theme, six assigned research themes, two themes on materials strength data sheets and three themes involving the use of funds from other ministries and agencies (a portion of the Environmental Agency's budget package and the Mining and Manufacturing Industry Technology Promotion Funds).

1) New Superconductor R&D

[Theoretical Core]

Theoretical research on the electronic structure of high-temperature superconductive substances and on the mechanisms of superconductivity

[Database Core]

A. Construction of a database to aid in the development of new superconductive materials
B. Research studies on trends in superconductor applications

[Raw Materials Control Core]

A. Research on the high-level purification of active metals for use in superconductive raw materials
B. Research on all of the characteristics of superconductive raw-material powders for use in high-pressure molding
C. Research on the manufacturing of superfine oxide compounds for use in superconductive materials
D. Research on fused-quenching-solidification-based production of raw-material powders for use in superconductors

[Thin Film Core]

Research on applying reactive layering techniques in superconductive oxide thin films

[Composite Processing Core]

A. Basic research on technology for fabricating special wiring materials from superconductive materials
B. Research on gas-phase-reaction-based technology for fabricating tape from new superconductive materials
C. Research on technology for producing new superconducting materials using chemical reaction methods
D. Research on solid/liquid-phase-reaction-based technology for fabricating wiring materials from new superconducting materials

[Superconductor Performance Evaluations Core]

Development of super-strong magnets

2) Special Research

A. Research on the development of inter-metallic composite materials for use in high-performance light-emitting devices
B. Basic research on laser-beam-based non-contact evaluation
C. Materials R&D for ultra-low-temperature-use devices
D. Research on the development of light-weight, heat-resistant inter-metallic composite materials

3) Nuclear Power Research

A. Research on the development of high-performance inter-metallic composite materials for nuclear power applications
B. Research on the corrosion-resistance of welded sections of nuclear fuel reprocessing equipment
C. Research in connection with evaluating low-temperature brittleness of metals used in nuclear fuel transport containers
D. Research in connection with evaluating corrosion-resistance of artificial barrier materials used in underground disposal
E. Research on the characteristics of new superconductive wiring materials for use in fusion reactors
F. Research on low-induction radioactive materials
G. Research on technology for analyzing and evaluating radiation damage when it occurs in materials
H. Research on ion-beam-based technology for predicting the strength and lifetime of materials in irradiated environments
I. Research on advanced damage and lifetime assessments of structural materials used in high-temperature gas reactors
J. Research on the correlation between corrosion fatigue and stress corrosion cracking of metals used in light-water reactors

4) Research based on the Coordination Funds for Promoting Science and Technology

(Comprehensive Research)

A. Research on the basic technology for developing functionally gradient materials for the purpose of mitigating thermal stress
B.Research on knowledge-based systems to be used as an aid in the design of chemical substances and other such activities
C. Research, based on international cooperation, on the elucidation of physical, chemical, and biological phenomena in microgravity environments

D. Research on basic technology for creating new functional materials that is based on the high-purification of rare metals
E. Research on basic technology for creating new materials that is based on hybrid structure design techniques (II)
F. Research on ultra-high vacuum generation, measurement, and utilization technology
G. International joint research on technology for testing and evaluating new materials
H. Research on ultra-high temperature generation, measurement, and utilization technology

(Priority Basic Research)

A. Basic research on micro-compositization techniques using CVD (chemical vapor deposition) methods
B. Basic research on technology for creating semiconductor quantum well fine lines
C. Basic research using ion-beam methods to elucidate the mechanisms by which the unique electroconductive characteristics of thin-film surfaces change
D. Research on the ultrasonic-microscope-based analysis of deformation and destruction behavior in composite materials
E. Research on using electron-beam lithograph to measure and elucidate the elementary processes of materials damage
F. Research on the production of inter-metallic compounds using combustive synthesis

(Individually Important International Joint Research)

A. Research on the vaporized extraction characteristics of gallium (with China)
B. Research on super-strong magnets (with the United States)

(Emergency Commissioned Research)

A. Emergency research on the production and molding/combustion of fine aluminum alloys using high-pressure liquid atomization techniques

5) Specific Joint Government-Private Research

A. Research on technology for producing high-performance superconductive materials

6) Assigned Research

A. Research on toughening mechanisms for and improving the characteristics of titanium alloys
B. Research on technology for extracting gallium and other valuable metals
C. Research on the plasma-resistant and radiation-resistant characteristics of materials used in the first wall of fusion reactors
D. Research on creating and evaluating the characteristics of functional inter-metallic compounds
E. Research on the creation of special fine particles and the elucidation of their properties
F. Research on converting lifetime estimates for materials into knowledge

7) Materials Strength Data Sheets

A. Fatigue data sheet publication (III)
B. Creep data sheet publication (III)

8) Research based on Funds from Other Ministries and Agencies

A. Research on the development of solid-state $SO_x$ and $NO_x$ electrolyte sensors
B. Composite materials R&D
C. High-performance crystal-control alloys

9) Commissioned Research, Joint Research, and Commissioned Testing

The institute was involved in 4 commissioned research items, one of which was "The Evaluation of Creep Rupture Characteristics in High-Cr Steel Welded Joints." It carried out joint research on 54 research items, one of which was "Research on Production Methods for and Mechanical Characteristics of High-Purity SiC Sintered Bodies."

As for commissioned testing, the institute performed 19 creep tests and 13 creep rupture tests.

## Chapter 3. National Institute of Radiological Sciences

### (1) General Situation

Since its inauguration in 1957, the National Institute of Radiological Sciences has brought forth many results from its research studies on the use of radiation in medicine and on radiation damage in humans and its prevention, diagnosis, and treatment. The institute also trains and educates technical personnel engaged in these kinds of research activities. With advancements in peaceful uses for nuclear energy, the importance of safety research on environmental radiation has increased, and social concern about the use of radiation in medicine is intensifying. Accordingly, the institute must build upon its past achievements and must work towards further advances in research studies such that it responds to social and national demands and achieves its original long-range objectives.

In view of the aforementioned circumstances, the institute adopted an operational plan for FY 1988 and carried out research studies, basing these on the "Long-Term Nuclear Power Development and Utilization Plan" prescribed by the Atomic Energy Commission (June 1987), the "FY 1988 Basic Program for Nuclear Power Development and Utilization" prescribed by the Prime Minister (March 1988), the "Yearly Program for Research on Environmental Radiation Safety" (October 1985) prescribed by Nuclear Safety Commission, and the Council for Science and Technology's reports entitled "Mid- and Long-Term Models for National Test

Research Institutions" and "Long-Term Operational Plans for the National Institute of Radiological Sciences" (April 1984).

1) Regarding special research, the institute is striving to clarify expected objectives, to draw up appropriate action plans with which to achieve those objectives within a given time frame, to maintain its research system, and, in continued cooperation with concerned internal and external organizations, to work towards further advancements.

The institute implemented the following special research subjects during FY 1988.

A. Biological research studies involving assessing the risks to the public of radiation exposure (begun in FY 1988)

B. Research studies on the use of heavy-particle beams and other kinds of radiation in medicine (begun in FY 1984)

C. Research studies involving assessing the risks to the public of exposure associated with the environment and food chains (begun in FY 1988)

2) Regarding assigned research, in accordance with the ideas of the long-term operational plans and other guidelines, the institute selected those particular research subjects that should be agrressively promoted, strove to effectively implement those subjects, and endeavored to further perfect the content of those subjects. It implemented five assigned research subjects during FY 1988.

3) As for ordinary research, the institute promotes research studies that are continually adapted to changes in the circumstances encountered and to advances in research, and endeavored to round-out its research in such a way as to heighten academic standards. It implemented 60 ordinary subjects during FY 1988.

4) The Technology Department worked towards making appropriate use of the laboratory's public experimental facilities and equipment so that research operations can be carried out smoothly. The department strove for efficient employment of the internal exposure experimentation facilities so that problem-free plutonium experiments may be carried out there.

Regarding the use of the medical cyclotron, the Technology Department strove for even more effective utilization of that facility, the results of which have had an impact on clinical research, diagnosis and treatment.
The department also systematically maintained equipment in the positron facilities in its efforts to strengthen and perfect nuclear medical research.

5) With the close cooperation of all concerned departments, the Training Department trained and drilled technical personnel involved in activities such as radiation protection and the use of radioisotopes in medicine. As a part of emergency medical treatment measures for dealing with radiation exposure, the department trained and drilled the necessary emergency rescue personnel.

6) The Hospital Department, in close cooperation with all concerned departments, made progress in its medical treatment operations, basing its efforts on the fruits of medical results it obtained in previous years. The department strove for rational management of its diagnosis and treatment operations, starting with medical treatment based on the use of a cyclotron, and worked towards further perfection in that management. The Hospital Department also promoted special diagnostic and treatment research.

As for emergency treatment measures for dealing with radiation exposure, the department, in close cooperation with each concerned department, worked towards perfecting those measures.

7) Facilities and Equipment

During FY 1988, the institute carried out systematic improvements to the water supply equipment on the premises and implemented environmental conservation measures.

8) In order to contribute to further advances in its research studies, the institute made use of systems such as the Honorary Research Official System, the Visiting Researcher System, and the Nuclear Energy Research Exchange System, and endeavored to further perfect and invigorate exchange with related internal and external organizations.

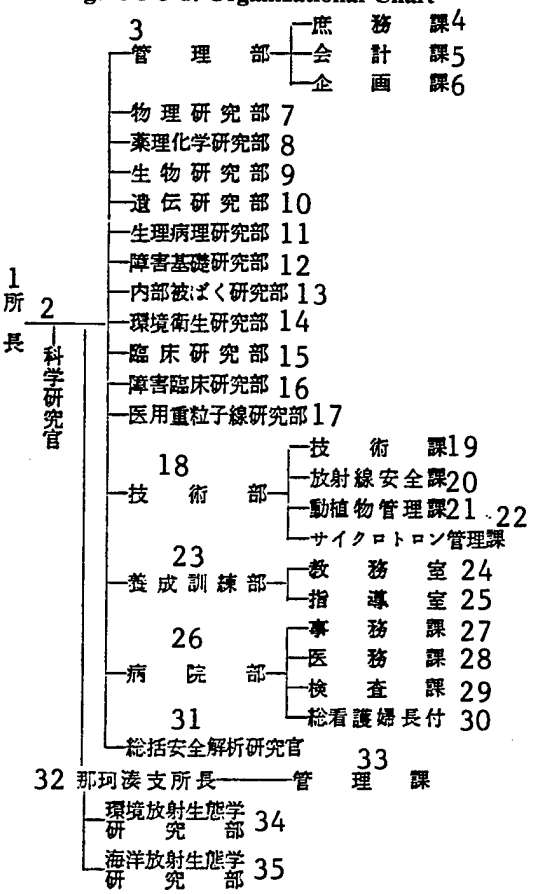
**(2) Organization and Personnel**

**FY 1988 Personnel (Number of people)**

| Section | Number |
|---|---|
| Appointed positions | 2 |
| Research positions | 209 |
| Administrative positions (1) | 118 |
| Administrative positions (2) | 20 |
| Medical positions (1) | 10 |
| Medical positions (2) | 10 |
| Medical positions (3) | 28 |
| Total | 397 |

In order to conduct inter-disciplinary research aimed at the development of new active substances and to make the best use of results and knowledge in fields such as biochemistry, synthetics chemistry, and pharmacology, the institute reorganized the "Chemistry and Pharmacology Research Department" and established the new "Pharmaco-Chemical Research Department". The institute also changed the labs and other facilities for the Biological Research Department and the Physiology and

**Figure 3-3-1. Organizational Chart**




Key:—1. Director—2. Scientific Research Officials—3. Administrative Department—4. General Affairs Department—5. Accounting Department—6. Planning Department—7. Physical Research Department—8. Pharmaco-Chemical Research Department—9. Biological Research Department—10. Genetics Research Department—11. Physiology and Pathology Research Department—12. Disorders Basic Research Department—13. Internal Exposure Research Department—14. Environmental Sanitation Research Department—15. Clinical Research Department—16. Disorders Clinical Research Department—17. Medical-Use Heavy-Particle Beam Research Department—18. Technology Department—19. Technology Section—20. Radiation Safety Section—21. Plant and Animal Management Section—22. Cyclotron Management Section—23. Training Department Section—24. Educational Affairs Section—25. Guidance Section—26. Hospital Department—27. Administrative Section—28. Medical Affairs Section—29. Examination Section—30. Chief of Nursing Attachment—31. General Safety Analysis Research Officials—32. Naka-minato Branch Office Director—33. Management Section—34. Environmental Radioecology Research Department—35. Marine Radioecology Research Department

Pathology Research Department to further strengthen the system for advanced research in radiation risk assessment and minimization technology. The institute added one new staff member to reinforce its research on the development of a heavy-particle-beam equipment for cancer treatment (otherwise, in accordance with the 7th staff reduction plan, the institute reduced its staff by three). At the end of FY 1988, there are 397 people on the staff.

### (3) Budget

The total budget expenditures for FY 1988 were ¥8,117.767 million (debit, ¥5,704.0 million). This represents an increase of ¥1,032.933 million (debit, ¥2,604.4 million) over the originally estimated budget (an increase of 14.6%).

Major budget expenditures were: ¥297.214 million for special radiotherapeutic research; ¥1,204.913 million (debit ¥3,014.0 million) fo heavy-particle-beam cancer treatment equipment; ¥515.88 million (debit ¥2,690.0 million) for facilities costs associated with this equipment; ¥935.0 million for real estate purchases in connection with this equipment; ¥1,355.379 million for operating costs for special experimentation facilities; ¥361.271 million for cyclotron equipment maintenance; ¥13.440 million for safety analysis research expenditures; ¥340.664 million for ordinary research expenditures; ¥116.790 million for facilities maintenance expenditures; ¥80.947 million for safety management and waste treatment measures; ¥310.240 million for the Hospital Department's expenditures; ¥98.968 million for equipment upkeep and other maintenance of facilities and equipment.

In addition to the that mentioned above, there were ¥137.221 million in expenditures associated with radioactivity surveys.

**FY 1988 Budget (Unit: ¥1000)**

| Item | Budget Amount |
|---|---|
| Personnel expenditures | 2,407,359 |
| Ordinary operations expenditures | 459,089 |
| Management of each department | 1,833,440 |
| Commissioned research expenditures | 994 |
| Special radiotherapeutic research | 297,214 |
| Hospital department diagnosis and treatment expenditures | 270,523 |
| Safety research operations | 13,440 |
| Safety management and waste treatment expenditures | 80,947 |
| Facilities and equipment maintenance expenditures | (debit)<br>2,690,000<br>1,549,848 |
| Heavy-particle-beam cancer treatment equipment R&D | (debit)<br>3,014,000<br>1,204,913 |
| Total | (credit)<br>5,704,000<br>8,117,767 |

**(4) Research Operations**

1) Special Research

During FY 1988, ¥297.214 million was appropriated as expenditures needed for special research operations.

A summary of special research objectives and programs for this fiscal year is given below.

Incidentally, by way of investigations and deliberations by the Comprehensive Research Council, which is an advisory organ to the director of the institute, and groups organized for each special research subject, the institute strove to get a grasp on the state of advancements in research studies and to systematically promote special research.

A. "Biological Research Study on Assessing the Risks to the Public of Radiation Exposure"

This research study is a newly organized, 5-year program that was started in FY 1988 for the purpose of finding solutions to all of the biological problems that are correlated with risk assessments in the general public. With the current internal and external research trends, the Long-Term Nuclear Power Development and Utilization Plan, and the professional achievements accumulated at the institute as background, the goals of this research are to establish the basic technology for risk assessment and minimization.

During FY 1988, the institute selected three research subjects, organized the appropriate research groups, and began the research studies needed to achieve its objectives. These subjects are: experimental research that can directly contribute to assessing the risks of the effects of low-dose/low-dose-rate exposure on the human body; understanding the mechanism of radiation effects (probabilistic) due to the introduction of new technology in fields such as the life sciences, and understanding the modification/alteration factors associated with those mechanisms; research studues in connection with assessing the risks of internal exposure due to transuranic elements, which will become the basis on which the nuclear fuel cycle is established.

- Experimental research studies for the purpose of assessing radiation risks
- Molecular and cellular biological research studies on the effects of radiation that is due to the introduction of new technology and associated modification factors
- Research studies to assess the risks of internal exposure due to transuranic elements

B. "Research Study to Assess Public Radiation Exposure Associated with the Environment and Food Chains"

This research study builds upon the basic concept, gained from previous environmental special research, for a computational model of the channels through which radioactive exposure in humans is passed down from the environment. This research takes into consideration the operations of large nuclear fuel cycle facilities, starting with spent-fuel reprocessing plants, and searches after the transitions of radioactive nuclides and transuranic elements from the environment and food chains into the human body via inhalation or oral intake.

After shedding light on metabolism according to radioactive nuclide age group and according to physical characteristics of Japanese people, this research aims to improve the accuracy of a system for calculating radiation exposure in the Japanese people. It is a newly organized 5-year program that was started in FY 1988, the objective of which is to investigate radioactive substance oral ingestion limits (induction limits) for the public.

For this effort, the institute selected three research subjects, organized the appropriate research groups, and began the research studies needed to achieve its objectives.

- Research on parameters for evaluating environmental safety
- Research related to setting up metabolism models for the public
- Developing an exposure-dose assessment model for establishing induction limits

C. "Research Studies on the Medical Use of Heavy-Ion Beams"

Building upon the results of "Research Studies on the Use of Particle Accelerators in Medicine," special research that was conducted from FY 1979-83, the institute has been promoting this 5-year research program since FY 1984 for the purpose of making cancer diagnosis and treatment more effective.

In connection with cancer diagnosis, the institute endeavored to improve imaging diagnostic technology that is based on not only x-ray CT (computerized tomography) and MRI (magnetic resonance imaging), but, in particular, on the use of positron CT. As for treatment, on the other hand, the institute conducted research to clarify which kinds of cancers should be treated with heavy-particle beams, which have both the superior biological effects of fast neutron beams and the nicely concentric dose distributions of proton beams.

The institute also carried out the research studies needed for the production of heavy-particle-beam equipment for cancer treatment. Furthermore, it worked towards activating nuclear medicine research using its positron facilities that were completed in FY 1986.

During FY 1988, the institute implemented research studies in the following research groups.

- Research on heavy-particle-beam equipment for treating cancer
- Research studies on systems that use heavy-particle and other kinds of beams for treatment

- Research studies on medical diagnosis for heavy-particle-beam treatment

2) Assigned Research

During FY 1988, the institute actively promoted the following subjects which it set up as those that should be aggressively promoted in accordance with the long-term operational plan and other guidelines.

1. International cooperative research on nuclear data for medical treatment with neutron beams
2. Research on the mechanisms by which chromosomal aberrations are induced in fertilized mouse eggs
3. Research on radioactive nuclide shifts in fetuses
4. Development of early-stage non-invasive methods with which to evaluate the effects of treatment for various kinds of cancers
5. Basic research on bone-marrow transplants and high doses of hematogenic genes to counter-act acute radiation hematogenic disorders

3) Safety Analysis Research

As a core organization involved in research on the biological effects of radiation, the institute has been maintaining and strengthening a professional system for radiation risk assessment so that it can contribute to the promotion of Japan's nuclear safety administration, starting with the work of the Nuclear Safety Commission.

During FY 1988, the institute equipped itself with an information management system for risk analysis and assessment and used this system to gather and organize data. It also developed a risk-analysis program for calculating doses and health effects. The institute appropriated ¥13.440 million to cover the costs of this research.

4) Investigations on the State of Affairs

The institute investigated the actual state of affairs in connection with particularly important research study and used those results to promote research studies.

¥2.207 million was appropriated to cover the operational costs of these research studies during FY 1988.

5) Commissioned Research

When the institute is commissioned to carry out research studies by other organizations, it implements only that which contributes to its own research and which does not hinder its own research operations. The institute appropriated ¥994,000 for commissioned research costs in FY 1988.

6) Radiation Investigations and Research

The institute investigated and analyzed environmental radiation levels which, with developments in the peaceful uses of nuclear energy, are attributed to radioactive substances that are released from nuclear power facilities and to radioactive fallout that accompanies nuclear explosion experiments. Also, in work continued from the previous year, the institute measured concentrations of radon and thoron and their daughter nuclides in order to aid in estimating doses in Japan's citizens.

The institute managed the operations of a data center for collecting, organizing, and storing information on radioactivity in Japan and overseas, and conducted basic investigations on the evaluations of results from radioactivity studies.

In order to improve the technical standards of environmental radiation monitoring in Japan, the institute conducted technical training sessions for concerned personnel in urban and rural prefectures.

Furthermore, the institute promoted investigations/measurements and research for the purpose of establishing measures for counter-acting the effects of radiation exposure in the human body that are due to nuclear power plant disasters, the effects of environmental radioactive pollution, etc. It educated and trained rescue personnel in measurement, protection, rescue exposure assessment, and other methods to be used when an emergency exposure occurs. ¥137.221 million was appropriated to cover the costs of these activities during FY 1988.

Research studies on radioactivity during FY 1988 included the following activities.

1. Investigating radioactivity levels and doses in the environment, food stuffs, and in human bodies
2. Investigating areas near nuclear power facilities
3. Radioactivity data center operations
4. Basic studies in connection with the results of radioactivity investigations
5. Training technical personnel for environmental radiation monitoring
6. Investigations of emergency exposure measurements and counter-measures

7) Research based on the Coordination Funds for Promoting Science and Technology

During FY 1988, the institute implemented research on the following 13 subjects.

| Research subject | FY 1988 Budget Amounts |
|---|---|
| (Development of common basic technology to support cancer research)<br>1 Development of technology for gene referencing and cell modification using those references in connection with the introduction of DNA, and improved methods of active oncogene detection before cancer becomes pathological | 11,869 |
| (Development of common basic technology to support cancer research)<br>2 Research on the development of technology for refining sugar-transferring enzymes | 7,150 |
| (Research on the development of basic techniques for elucidating immunity response mechanisms)<br>3 Research on models for bone-marrow transplant methods in connection with virally induced immunity incompleteness | 6,391 |
| (Research on the development of chromosomal analysis and utilization technology )<br>4 Development of techniques for analyzing inherited placental weak sections in chromosomes | 18,502 |
| (Research on the development of technology for advanced, high-resolution, non-destructive measurements at biomolecular levels)<br>5 Development of technology for in vivo analysis of glycolipid metabolism and other such processes | 8,179 |
| (Priority basic research)<br>6 Research on the obstructive action of "activated oxygen" and preventative mechanisms | 7,973 |
| 7 Research on mamalian post-implantation-stage embryo culture methods | 5,446 |
| 8 Cellular engineering research on the cellular factors that play a part in the destabilization and recombination of chromosomes | 5,947 |
| 9 Research on self-destructive death manifestation as a higher-order biological control and restoration mechanism | 4,270 |
| 10 Research on macrophage development and organism-specific differentiation | 5,316 |

8) Special Joint Government-Private Research

The institute implemented effective and efficient R&D activities involving joint research with individuals outside of national organizations, and joint research that went beyond the confines of Japan's research personnel and organizations. During FY 1988, the institute carried out the following research subjects.

1 Development of methods for examining the dynamic functions of the brain using positron emission isotopes

**(5) Development of Heavy-Particle-Beam Equipment for Treating Cancer**

In order to realize the early-stage utilization of the effects of heavy particles, in which the superior biological effects of fast neutron beams and the sharp dose distribution of proton beams are combined, the institute looked over its previous experience and achievements in the use of various kinds of radiation to treat cancer, obtained the opinions of related committees and other groups, and, with the close cooperation of concerned departments, continued work from the previous year on ion sources for the heavy-particle beam and the production of the first part of the accelerator, then began the new production of the main accelerator. The institute also continued working on the detailed design of a building to house the heavy-particle-beam equipment and started construction of the foundation.

1) Producing Each Section of the Equipment

The institute produced the ion source, the first part of the accelerator, and its control systems; continued the developmental research needed for that production from the previous year; and, building upon the detailed design from the year before, decided upon the final performance and specifications of the main accelerator and started production. The institute also tested range-shifter prototypes and other equipment needed in the production of the equipment.

2) Detailed Design and Building Construction for the Heavy-Particle-Beam Equipment

Together with the developments in the detailed design of the equipment, the institute continued work from the previous year on the detailed design of a building suitable for the equipment and the necessary supplemental equipment and facilities. The institute settled on the final specifications for the entire facility after repeated studies on the shielding design, the establishment of management boundaries, flow diagrams, and so forth, and began construction.

**(6) Exchange with National and Foreign Organizations**

1) Guest Research Officials

In order to activate the institute and efficiently and effectively promote research operations, the institute provides a system for guest research officials.

During FY 1988, the institute allowed outside researchers to participate in the planning of projects such as the development of the heavy-particle-beam equipment for treating cancer, the institute's highest priority project, and aggressively promoted that project. The institute appropriated ¥7.016 million to cover the costs of these activities.

2) Visiting Researchers from Outside of the Institute

In order to gain the cooperation of specialized researchers from outside of the institute and to work towards improving the mutual exchange of knowledge and research results, the institute provides a system for visiting researchers.

During FY 1988, ¥7.635 million was appropriated for visiting researchers, who were assigned to their respective sections.

3) Nuclear Power Research Exchange

Based upon the guidelines adopted by the Atomic Energy Commission (December 1984), the institute strove to keep in contact with concerned government-led research organizations, to invite researchers from developing countries to Japan's research organizations, to dispatch Japanese nuclear power researchers to developing countries, and to promote international research cooperation with developing countries in nuclear power fields.

The institute also promoted international research exchange in related research fields by sending its researchers to live abroad and by inviting foreign researchers to Japan.

Furthermore, it made use of the Coordination Funds for Promoting Science and Technology for individually important international joint research and strove to promote internationalization and to improve the degree of its international contributions.

**(7) Training Operations**

During FY 1988, the institute followed the guidelines of the long-term operational plans and appropriated ¥8.599 million for management and operations of its training activities. The institute strove to perfect the contents of its curricula, and, with the close cooperation of concerned research departments, implemented the following 8 courses and trained 180 scientific and technical personnel. Through efficient and rational management, the institute endeavored to improve the effectiveness of training sessions.

As for training and drilling systems inside and outside of the institute, it conducted the research studies needed to improve research results.

The training classes conducted by the Training Department from FY 1959 to FY 1988 are shown in the table below. The total number of people who finished these courses was over 4,210.

| Course | Number of People | Registration Period | Course Period |
|---|---|---|---|
| 74th Radiation Protection Course | 30 | mid January to early March 1988 | early April to mid June 1989 |
| 75th Radiation Protection Course | 30 | early February to mid April 1988 | late May to late June 1988 |
| 17th Emergency Exposure Rescue Training Course | 15 | late March to late May 1988 | early July 1988 |
| 11th Environmental Radiation Monitoring Course | 30 | early July to early September 1988 | mid October 1988 |
| 18th Emergency Exposure Rescue Training Course | 15 | mid June to mid August 1988 | late September 1988 |
| 76th Radiation Protection Course | 30 | late July to mid September 1988 | early November to early December 1988 |
| 40th Radiation and Nuclear Medicine Fundamental Course | 14 | late September to late October 1988 | mid January to mid February 1989 |
| 24th RI Utilization Biology Course | 16 | late September 1988 to late November 1988 | mid January to mid February 1989 |

| Course | Year established | Number of Trainees | Remarks |
|---|---|---|---|
| Radiation Protection Course | FY 1959 | 2,347 | The international course (1 time) includes 22 people<br>The medical observation course (3 times) includes 70 people |
| Radiation and Nuclear Medicine Fundamental Course | FY 1961 | 596 | |
| RI Utilization Biology Course | FY 1965 | 354 | |
| Environmental Radiation Monitoring Course | FY 1978 | 280 | |
| Emergency Exposure Rescue Training Course | FY 1979 | 370 | |
| Radiation Drugs Course | FY 1964 | 263 | Was changed to the Radiation Protection Course in FY 1976 |
| Total | | 4,210 | |

### (8) Diagnosis and Treatment Operations

The Hospital Department, with 78 beds and ¥301.240 million budgeted for management costs, was effective in maintaining and improving the standards of its diagnosis and treatment technology and in making its management more smooth and efficient.

Accordingly, the department gave the following items priority in each of its areas and took precautions in carrying out all diagnosis and treatment research.

1. Research on radiation damages involved the diagnosis and treatment of both acute and latent damages and follow-up investigations. The department also conducted research that involved repeated clinical case studies of evaluations of normal tissue damage in connection with the diagnosis and treatment of patients with malignant tumors.
2. In radiation diagnosis research, the department strove for an overall improvement in imaging diagnostic techniques, including the use of positron CT and MRI.
3. In radiotherapy research, the department conducted clinical evaluations of particle-beam treatments and endeavored to improve collective therapeutic techniques. In particular, the department gave priority to research that clarifies the suitability of heavy-particle beam therapy.
4. In connection with special diagnosis and treatment research, the department systematized its diagnosis and treatment operations and, as a part of its operations, gave priority to research on the processing and analysis of medical information.

In implementing the aforementioned activities, the department endeavored for close cooperation so that it could gain the support and cooperation of a broad spectrum of specialists from inside and outside of the institute.

### (9) Emergency Exposure Medical Measures

In coping with the necessity of policies on maintaining emergency medical systems, as indicated in the Nuclear Safety Commission's report entitled "On Disaster Measures in Areas Near Nuclear Power Plants" (June 1980), the institute maintains its own systems, maintains equipment and instrumentation for emergency radiation exposure treatment, and trains nurses and rescue personnel as a part of emergency treatment measures for dealing with nuclear disasters caused by nuclear power plant accidents.

Additionally, in light of the items indicated in the Nuclear Safety Commission's "Special Committee Report on the Investigation of the Soviet Nuclear Power Plant Accident" (28 May 1987), the institute conducted studies on the construction of a network to link the institute with concerned organizations.

## Chapter 4. National Research Center for Disaster Prevention

### (1) General Situation

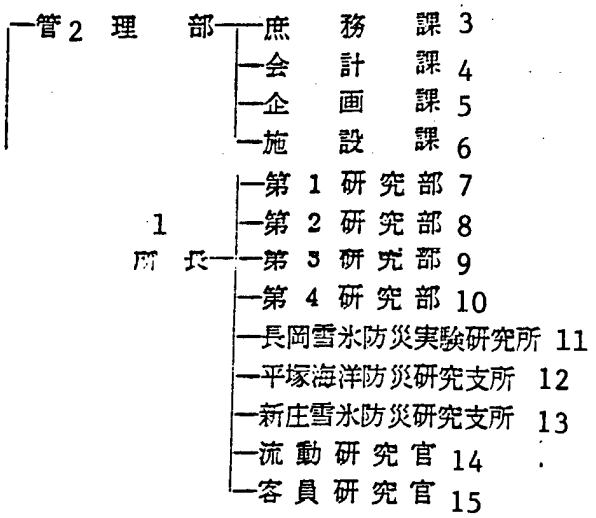
As a key organization involved in Japan's comprehensive disaster prevention S&T, the National Research Center for Disaster Prevention, since its inauguration in FY 1963, has consistently promoted test research on disaster prevention S&T, gathered and organized disaster-related materials, and overseen the management and maintenance of large public facilities.

During FY 1988 as well, the center aimed to systemize and improve the standards of research in disaster prevention S&T. In particular, it gave priority to research related to earthquakes and snow damage, and strove to strengthen its basic and comprehensive test research.

A breakdown of its test research is: special research, three fields and eight subjects; assigned research, two subjects; ordinary research, nine fields and 39 subjects; joint research, one field; research based on the Coordination Funds for Promoting Science and Technology, 10 subjects (six general research, two priority basic research, one individually important international joint research, and one inter-agency basic research subjects); research based on the Marine Development Research Studies Promotion Funds, one subject; research based on the National Organizations' Atomic Energy Test Research Funds, one subject.

### (2) Organization

**Figure 3-4-1. Organizational Chart**




Key:—1. Director—2. Administrative Department—3. General Affairs Department—4. Accounting Department—5. Planning Department—6. Facilities Department—7. 1st Research Section—8. 2nd Research Section—9. 3rd Research Section—10. 4th Research Section—11. Nagaoka Snow and Ice Disaster Prevention Experimental Laboratory—12. Hiratsuka Marine Disaster Prevention Experimental Laboratory—13. Shinjo Snow and Ice Disaster Prevention Experimental Laboratory—14. Circulating Research Officials—15. Guest Research Officials

### (3) Budget and Personnel

The center's budget for FY 1988 was ¥2.56 billion; if the research expenditures allocated from the Coordination Funds for Promoting Science and Technology, the Marine Development Research Studies Promotion Funds, and the National Organizations' Atomic Energy Test Research Funds are included, the total amount was approximately ¥2.83 billion. (Table 3-4-1)

**FY 1988 Budget (Unit: ¥1000)**

| Item | FY 1988 Budget Amount |
|---|---|
| Personnel expenditures | 725,221 |
| Costs of maintaining facilities for observing crustal activity | 9,234 |
| Costs of maintaining facilities for earthquake prediction research | 34,617 |
| Commissioned research | 4,786 |
| Special disaster prevention S&T research | 962,549 |
| Disaster prevention research facilities and equipment maintenance promotion | 406,008 |
| General facilities maintenance | 9,254 |
| Total | 2,562,801 |

In addition, ¥20 million of Science and Technology Promotion Funds (special joint government-private research) was set aside as reserve funds, and ¥18.3 million was approved as expenditures needed to cover the cost of strengthening the emergency observation and surveillance system in connection with the Mount Tokachi eruption. As for personnel, one person left, making a total of 117 staff members.

**FY 1988 Personnel (Number of people)**

| Section | Number |
|---|---|
| Appointed positions | 1 |
| Research positions | 76 |
| Administrative positions (1) | 33 |
| Administrative positions (2) | 7 |
| Total | 117 |

### (4) Research Operations

1) Special Research

1. Earthquake disaster counter-measures special research

A. Research on earthquake activity in the southern part of metropolitan Tokyo

In order to contribute to research in predicting earthquakes whose epicenters are in and around Tokyo, the center used deep-well crustal activity observation facilities (in three places: Iwatsuki, Shimosa, and Fuchu) to observe micro-earthquakes and crustal tilt, and to conduct research on the correlation between earthquakes that can be felt, on one hand, and micro-earthquake activity and crustal alterations on the other.

B. Research on crustal activity in the Kanto and Tokai regions

To get a general grasp on the crustal activity in the Kanto and Tokai regions, regions which were designated as "Regions for Intensified Observation" by the Earthquake Prediction Liaison Council, and to promote research on earthquake prediction, the center used an earthquake-precursory-phenomena analysis system and then carried out centralized processing and analysis of observational data in Tsukuba.

C. Research on the mechanisms of earthquake occurrence

To aid in elucidating the mechanisms by which earthquakes occur and develop, the center used hydraulic demolition methods to measure crustal stress in the southern part of Tochigi Prefecture and observed broadband vibrations and other phenomena in the eastern part of Yamagata Prefecture.

D. Research on predicting huge trench-type earthquakes

To aid in understanding the crustal activity of plate boundary areas (deep ocean areas), which are the focal

regions of huge earthquakes, the center conducted research that involved wide-area observations of marine earthquake activity using self-floating seabottom seismographs, observations using tiltmeters, and observations of volcanic activity on Iojima and Izujima.

E. Research in connection with techniques for predicting ground-surface earthquake damage

In order to establish techniques for predicting seismic characteristics and ground damage during a large earthquake for regions with different ground characteristics, the center selected the metropolitan Tokyo area as a test field and conducted seismological observations of strong earthquake activity there.

2. Special Research on Measures to Counteract Snow Damage

A. Research and development of technology for preventing snow damage in populated areas

To contribute to preventing snow damage in urban residential areas, the center measured sunlight distributions during periods of snowfall and conducted research in connection with preventing the building damage/collapse caused by the destructive force of accumulated snow on rooftops.

B. Research to elucidate the mechanisms of drifting snow occurences and to develop techniques for preventing snow-drift disasters

In order to prevent snow-drift disasters, which have become a factor in traffic obstructions, the center conducted research studies to shed light on the mechanisms by which drifting snow occurs and on the connection with temperature, wind speed, and snow quality. The center also began using Doppler radar in its observations.

3. Special Research on Climatic Disasters

A. Research on the mechanisms by which climatic disasters occur and the evaluation of those effects

The center began observational research for the purpose of elucidating the processes through which water vapor is supplied to form convective clouds and the mechanisms by which thunderstorms and torrential rains occur, research on methods for using satellite data to detect and evaluate flood damage, and research on methods for evaluating the danger of mountain slopes.

2) Assigned Research

1. Research on regional snowfall characteristics and radar information processing

2. Experimental research on predicting when slope cave-ins will occur

3) Ordinary Research

1. Abnormal climatic disaster prevention research

A. Basic research on atmospheric/marine thermal balance and fluctuations

2. Snow damage disaster prevention research

A. Research on the nature and behavior of snow drifts in warm regions
B. Research on the nature and behavior of snow drifts in cold-warm transition regions
C. Research on the correlation between long-term fluctuations in snow depths and climatic anomalies
D. Research on techniques for dealing with snow on rooftops and near buildings
E. Research on the development of scanning-type snow-depth meters
F. Statistical research on the occurrence of snow and ice disasters

3.Research on the prevention of ground-surface alteration disasters

A. Research on the distribution characteristics of large-scale landslides and on the prediction of those occurrences
B. Research on the correlation between hydrological characteristics of river basins in mountainous regions and the occurrences of earth and sand disasters
C. Research on the correlation between cave-ins of tablelands and hilltop slopes in and around urban areas and the hydrological characteristics of those areas
D. Research in connection with predicting the kinetics of slope cave-ins and landslides
E. Research on the mechanisms by which detritus flows occur and move

4. Wind and flood disaster prevention research

A. Developmental research on basic technology in connection with flood prediction
B. Research on large-area fluctuations in moisture content
C. Research on strong winds and the occurrence of coastal disasters

5. Earthquake disaster prevention research

A. Crustal structure observations
B. Research on the relationship between earthquake activity and crustal structure
C. Experimental and observational research on rock-bed warping/stress and water behavior
D. Observational research on the geochemical phenomena accompanying crustal activities
E. Research on earthquake occurrence models and patterns of seismic wave forms
F. Research on detecting changes in crustal activity using statistical methods

G. Research on earthquake precursory phenomena in Japan

H. Research Studies using a position-measuring satellite (GPS—global positioning satellite) in connection with continuous observation of wide-area crustal fluctuations

I. Developmental research on a rotational component seismograph

J. Research on methods for observing deep-sea crustal activity

K. Research on the occurrence and propagational characteristics of strong earthquakes

L. Research involving observations of seismic response in real-scale structural models

M. Research studies on evaluating earthquake-resistance

6.Research in connection with the prevention of volcanic eruption disasters

A. Research on the development of observational instruments for use on volcanoes

B. Research on the prediction of volcanic eruptions

C. Research on volcanic disasters and their prevention

7. Coastal disaster prevention research

A. Research on the characteristics of and prediction methods for abnormal coastal waves

B. Research on tsunami occurrences, propagation and coastal up-stream flow

8. Disaster prevention information processing technology

A. Research on remote-sensing information processing in connection with disaster prevention

B. Research on instrumentation and processing systems in connection with disaster prevention

C. Research and development of methods for dynamic simulation of disaster phenomena

D. Research on the construction of databases for disaster and disaster prevention S&T information

E. Research on the social impacts of disasters and recovery processes

4) Joint Research

1. Special joint government-private research

A. Research on the development of information systems for snow and ice disasters in traffic routes

2. Joint research with concerned organizations

A. Research on spatial and temporal fluctuations in earthquake activity using methods that analyize information content
B. Research on cave-ins of tablelands and hilltop slopes and hydrological characteristics of those areas
C. Comprehensive research on climatic fluctuations in the Antarctic
D. Developmental research on technology for predicting wave height, flow velocity, and other properties of tsunami in coastal areas

3. Joint research and invitions to foreign researchers

A. Research on predicting the seismographic strength of earthquakes
B. Research on seismic wave velocities in submerged belts of the Tonga Trench
C. Comparative research on technology for preserving water pressure (government-controlled mountains and water)

5) Research based on the Coordination Funds for Promoting Science and Technology

1. Comprehensive research

A. Research on the earthquake tectonics of active structural regions in central Japan
Crustal stress investigations
B. Research on the development of systems for predicting the degree of danger of earth and sand disasters
Research on methods for estimating the degree of danger of earth and sand disasters
C. Joint research with ASEAN countries on the advancement and applications of remote sensing technology
Understanding hydrologic balance characteristics and managing water resources (flood topography classification)
D. Research on the prediction of magnitude-7 inland earthquakes
i. Research using IBOS-based methods for observing crustal fluctuations
ii. Micro-earthquake observations
E. Joint international research on atmospheric and marine fluctuations in the Pacific and climatic changes
i. Observational research on the characteristics of changes in sea-ice
ii. Analytical research on the interaction between the atmosphere and the oceans using data from the MOS-1 and other satellites
F. Research on advancing technology for dealing with snow
i. Doppler radar observations
ii. Research on the quantitative and thermal flow mechanisms of wide-area underground waters
iii. Research on methods for snow disposal that can be used throughout the year
iv. Research on snow removal techniques

2. Important basic research

A. Research on elucidating the fluidization mechanisms of collapsing earth and sand
B. Research on isotope classification and wet-snow transformations in multi-phase snow and water systems

3. Individually important joint international research

A. Research in connection with getting an immediate grasp on crustal activity and detecting earthquake precursory phenomena

6) Research based on the Marine Development Research Studies Promotion Funds

A. Developmental research on marine remote sensing technology
Research on the measurement of waves and strong off-shore winds using microwave scattering meters

7) Research based on the National Organizations' Atomic Energy Test Research Funds

A. Research on evaluating the earthquake-resistance of support and coupling sections of equipment piping systems

## Chapter 5. National Institute for Research in Inorganic Materials

### (1) General Situation

Since its inauguration in FY 1966, the National Institute for Research in Inorganic Materials, a key organization involved in Japan's research on non-metallic inorganic materials, has promoted research on the creation of high-purity inorganic substances, which become the basis for new materials that meet the demands of the times, and research on the characteristics of these materials.

There are currently many expectations for the results of materials S&T: a means of coping with new energy development, energy conservation, and the transition to an information society. Of the new materials, the superb characteristics of non-metallic inorganic materials—heat resistance, corrosion resistance, electromagnetic conductivity, optical characteristics—are gaining attention.

Based on these kinds of circumstances, the institute is striving to promote even more research now and in the future.

During FY 1988, the institute reorganized three of the fifteen existing research groups that achieved their expected goals and restarted research in those groups after selecting bismuth-based oxyflourides, copper perovskites, and rare-earth garnets as the subjects for new research. As for making the most of previously gained research results, the institute, through the Research and Development Corp. of Japan, aimed at commercializing 62 inventions, one of which was a method for producing fibrous alkaline metal titanates, and worked towards applying the results of research on three themes that were carried over from previous years.

Furthermore, the institute participated in the planning of new superconductive materials R&D (the multi-core superconductive materials research project) and conducted research within three of the core areas.

### (2) Organization

The organization of the institute is shown in Figure 3-5-1.

### (3) Budget and Personnel

**Figure 3-5-1. FY 1988 Budget (Unit: ¥1000)**

| Item | FY 1988 Budget Amount |
|---|---|
| Superconductive materials R&D expenditures | (debit) 900,000<br>389,414 |
| Special research expenditures | 68,198 |
| Ordinary research expenditures | 414,077 |
| Research equipment expenditures | 197,985 |
| Facilities expenditures | (debit) 326,000<br>107,053 |
| Personnel expenditures | 1,080,609 |
| Total | (debit) 1,226,000<br>2,257,336 |

The budget for FY 1988, as shown in Table 3-5-1, was approximately ¥2.26 billion (including facilities operational costs). This represents an increase of approximately ¥190 million over that of the previous year. In addition, there were ¥28.807 million from the National Organizations' Atomic Energy Test Research Funds, ¥290.244 million from the Coordination Funds for Promoting Science and Technology, ¥25.0 million from the Science and Technology Promotion Funds, and ¥10.275 from the MITI Research and Development Project of Basic Technologies for Future Industries

**Figure 3-5-2. FY 1988 Personnel (Number of people)**

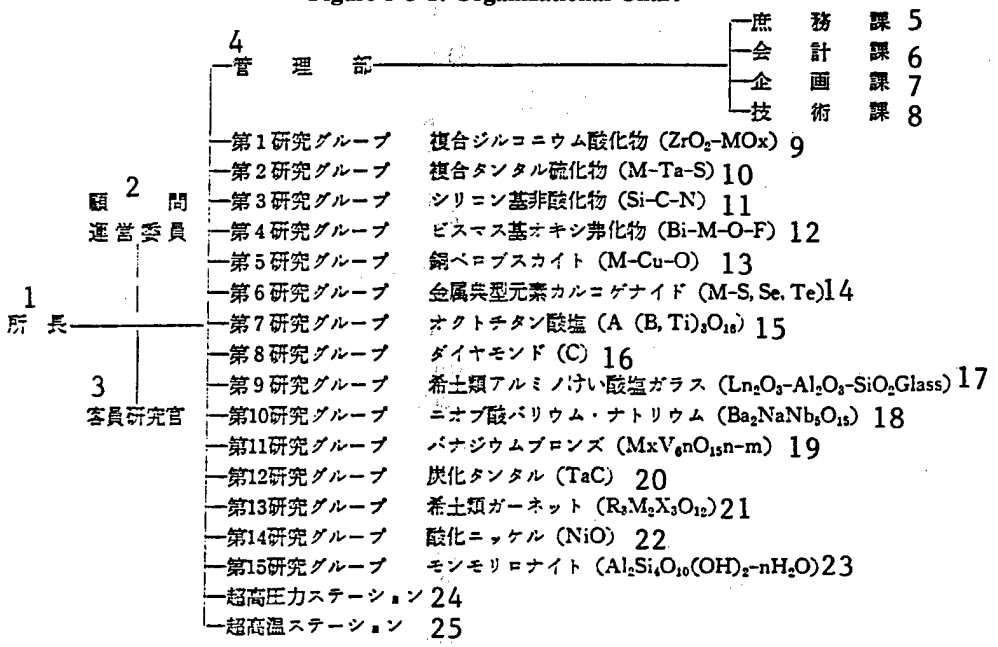
| Section | Number |
|---|---|
| Appointed positions | 1 |
| Research positions | 118 |
| Administrative positions (1) | 42 |
| Administrative positions (2) | 4 |
| Total | 165 |

As for personnel, there was one less person than the year before, for a total of 165 staff members.

### (4) Research Operations

1) Ordinary research
1. Research on complex zirconium oxides
2. Research on complex tantalum sulfides
3. Research on silicon-based non-oxides
4. Research on bismuth-based oxyflourides

**Figure 3-5-1. Organizational Chart**




Key:—1. Director—2. Management Advisory Committee—3. Guest Research Officials—4. Administrative Department—5. General Affairs Department—6. Accounting Department—8. Technology Department—9. 1st Research Group: Complex Zirconium Oxides ($ZrO_2$-$MO_x$—10. 2nd Research Group: Complex Tantalum Sulfides (M-Ta-S)—11. 3rd Research Group: Silicon-Based Non-Oxides (Si-C-N)—12. 4th Research Group: Bismuth-Based Oxyflourides (Bi-M-O-F)—13. 5th Research Group: Copper Perovskite (M-Cu-O)—14. 6th Research Group: Typical Metal Chalcogenides (M-S,Se,Te)—15. 7th Research Group: Octo-Titanates (A $(B,Ti)_3O_{16}$)—16. 8th Research Group: Diamonds (C)—17. 9th Research Group: Rare-Earth Aluminosilicate Glasses ($Ln_2O_3$-$Al_2O_3$-$SiO_2$Glass)—18. 10th Research Group: Barium Sodium Niobates ($Ba_2NaNb_5O_{15}$)—19. 11th Research Group: Vanadium Bronzes ($MxV_6nO_{15}n$-m)—20. 12th Research Group: Tantalum Carbides (TaC)—21. 13th Research Group: Rare-Earth Garnets ($R_3M_2X_3O_{12}$)—22. 14th Research Group: Nickel Oxides (NiO)—23. 15th Research Group: Montmorillonites ($Al_2Si_4O_{10}(OH)_2$-$nH_2O$)—24. Super-High Pressure Station—25. Super-High Temperature Station

5. Research on copper perovskites
6. Research on typical metal chalcogenides
7. Research on octo-titanates
8. Research on diamonds
9. Research on rare-earth aluminosilicate glasses
10. Research on barium sodium niobates
11. Research on vanadium bronzes
12. Research on tantalum carbides
13. Research on rare-earth garnets
14. Research on nickel oxides
15. Research on montmorillonites
16. Super-high-pressure-related research
17. Super-high-temperature-related research

2) Superconductive Materials R&D (multi-core superconductive materials research project)

1. New Substances Search Core

The institute used various methods, such as solid-phase synthesis (normal pressure solid-phase reaction, high-pressure/high-oxygen-depression solid-phase reaction) and gas-phase/liquid-phase synthesis, in its search for better superconducting substances with new compositions and new structures.

2. Simple-Crystallization Core

The institute researched the phase-equilibrium measurements and flux needed in the development of technology for synthesizing large simple crystals of high-temperature superconductive ceramic materials, developed device technology, and established crystal characterization methods.

3. Crystal Structure Analysis Core

The institute analyzed the crystal structures (local structure and mean structure) and the electronic structures of high-temperature superconductors, gathered the basic data needed for elucidating the mechanisms of superconductivity and for producing materials from superconductive substances, and provided data needed in the quest for new superconductive substances.

3) Special Research

1. Biofunctional ceramics research

The institute developed methods for manufacturing apatite water cements and porous apatite, developed a new type of high-pressure-generation device for manufacturing artificial bones, carried out experiments for obtaining compound materials made of apatite combined with substances such as metals, and evaluated the characteristics of newly obtained elemental materials.

2. Research on diamond semiconductor fabrication

The institute focused its efforts on synthesizing simple crystal film semiconductors and diamonds with few defects; it investigated synthesis conditions and evaluated the generated diamonds.

3. Super-abrasion-resistant materials R&D

The institute synthesized and analyzed sintered diamonds and sintered cBN (cubic boron nitride), which can be used as super-abrasion-resistant materials.

4) Research based on the National Organizations' Atomic Energy Test Research Funds
1. Research on radiation-resistant inorganic materials
2. Research on new inorganic scintillators
3. Research on highly functional solid electrolytes

5) Research based on the Coordination Funds for Promoting Science and Technology
1. Research on basic technology for creating new materials using hybrid structure design techniques (2nd term)
2. Research on ultra-high-temperature generation, measurement, and utilization technology (2nd term)
3. Research on the analysis and evaluation of high-performance functional materials using new beam technology
4. Research in connection with knowledge-based systems for supporting chemical substance design and other efforts
5. International joint research on technology for evaluating and testing new materials
6. Research on basic technology for creating new functional materials that is based on the high-purification of rare metals
7. Research on ultrahigh vacuum generation, measurement, and utilization technology

6) Important basic research based on the Science and Technology Promotion Funds
1. Research on the wavelength-convertibility of nonlinear optical crystals
2. Research on high-quality simple crystals of high-melting-point compounds

7) Individually Important Joint International Research based on the Coordination Funds for Promoting Science and Technology
- Research on the optical properties of diamonds (partner: UK)

8) Inter-agency Basic Research based on the Coordination Funds for Promoting Science and Technology
- Research on the influence of macro-cluster melted liquid structure on crystal growth

9) Special Joint Government-Private Research based on the Science and Technology Promotion Funds
- Research on the synthesis of sintered diamonds as radiation boards with super-heat-transfer characteristics

10) MITI Research and Development Project of Basic Technologies for Future Industries
- Fine ceramics R&D

## Chapter 6. National Resources Institute

(Reorganized into the National Institute for Science and Technology Policy, 1 July 1988)

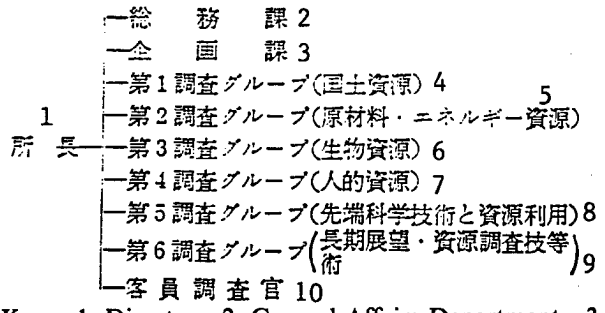
### (1) General Situation

Since its inauguration in June 1968, the institute has carried out investigations and analyses of basic items in connection with the comprehensive utilization of resources, and has gathered, organized, and analyzed internal and external data. The results of these efforts have been put to practical use in the activities of the Resources Council and resources-related policy-making in concerned adminsitrative organizations.

Today, amidst anticipated mid- to long-term expansion in the global economy, the demand for natural resources is expected to increase in developing countries, while in advanced countries, the promotion of policies to ensure the stablility of resources is expected. In Japan, limitations in the use of natural resources such as land, water, and forests, and labor shortages are foreseen. It is important for Japan, a country poor in natural resources, to overcome resource limitations by making the greatest possible use of its abundant, high-quality human resources and S&T. In view of internal and external trends and needs, the institute has come to promote investigative activities in continued close cooperation with the Science and Technology Policy Bureau and the Resources Council. During FY 1998 as well, the institute has attached great importance to issues such as 1) resource problems attendant upon the evolution of S&T, and 2) extracting technology development subjects that are related to resources development. The institute conducted general investigations on 10 subjects, one special investigation, and "Promoting the Effective Utilization of Remote-Sensing Information." Incidentally, the institute was reorganized into the National Institute for Science and Technology Policy on 1 July 1988.

### (2) Organization

**Figure 3-6-1. Organizational Chart**




Key:—1. Director—2. General Affairs Department—3. Planning Department—4. 1st Investigations Group (national resources)—5. Second Investigations Group (raw material and energy resources)—6. Third Investigations Group (biological resources)—7. Fourth Investigations Group (human resources)—8. Fifth Investigations Group (leading-edge S&T and resources utilization)—9. Sixth Investigations Group (long-term outlook and resources investigation techniques)—10. Guest Investigations Officials

The organization of the institute is shown in Figure 3-6-1.

### (3) Budget and Personnel

**Table 3-6-1. FY 1988 Budget (Unit: ¥ 1000)**

| Item | FY 1988 Budget Amount |
|---|---|
| Personnel expenditures | 66,506 |
| Ordinary operational expenditures | 6,019 |
| Investigations expenditures | 4,967 |
| (1) General investigations | 3,105 |
| (2) Special investigations | 1,862 |
| Total | 77,492 |

Note: This is a 3-month budget until 30 June 1988.

As for personnel, there were 42 staff members, as shown in Table 3-6-2.

**Table 3-6-2. FY 1988 Personnel (Number of people)**

| Section | Number |
|---|---|
| Appointed positions | 1 |
| Administrative positions (1) | 1 |
| Administrative positions (2) | 40 |
| Total | 42 |

### (4) Operations Summary

1) General Investigations

- Demonstrative investigations of comprehensive local energy utilization systems
- Investigation of the supply and utilization of fine ceramics resources
- Investigation of follow-ups to the 4th Japanese Food Standards Component Table
- Investigation of the significance and advanced utilization of green resources
- Investigation of the dietary habits of middle-aged and elderly people
- Investigation of human formation and the environment during infancy
- Investigation of 21st century civilization and resources problems
- Investigation of S&T activities and resources utilization
- Investigation of the directions of basic research that is aimed at innovative technology
- Investigation of the current state of R&D in software S&T and trends in future developments

2) Special Investigations

1. Research on the effects of growth in leading-edge S&T on the resources utilization

The aim of this research is to further clarify, from the standpoint of resource and energy conservation, case-studies of the effects of growth in leading-edge S&T—centering on information and electronics S&T, substance/materials S&T, and the life sciences—on resources utilization. Another goal is to examine measures for maintaining the resources needed to facilitate growth in these leading-edge S&T fields. During FY 1988, the institute investigated the actual state of R&D in leading-edge S&T fields and conducted the necessary investigations with which to analyze the effects of future S&T applications on resources utilization and to analyze the conditions for promoting leading-edge technology development in connection with resource utilization. (After 1 July 1988, these subjects were continued as special research study subjects at the National Institute for Science and Technology Policy.)

## Chapter 7. National Institute for Science and Technology Policy

### (1) General Situation

Today, Japan is being asked to take on a role, in proportion to its increasing economic strength, that is suited to its international position in various fields and to transform its structure to accommodate that role.

With the growing realization that advances in S&T are indispensable to the continued evolution of the global economy, the promotion of greater international cooperation and harmony, and the transformation to an R&D structure that centers on creative basic research is sought after.

On the other hand, there is a recognized need for S&T policies to cope with all the problems that arise: life ethics problems, international friction in S&T over the issue of access to R&D results, and other problems in the

relationship between S&T and society; growing deserts and other such global-scale environmental problems.

Accordingly, Japan, which is on the verge of a tremendous transitional period as it faces the 21st century, must aim for "Policy Innovation": the creation of new policies that correspond to an age in which Japan's former model, as the catch-up type with respect to the United States and Europe, no longer exists.

With these circumstances taken into account, the National Institute for Science and Technology Policy, a reorganization of the National Resources Institute, was established in July 1988 as an organization which carries out research studies for the sake of fresh development in timely and accurate S&T policy-making.

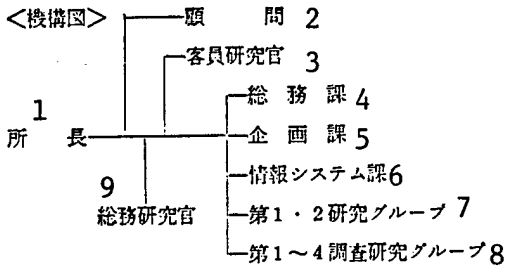
During FY 1988, the institute tackled six special research subjects and nine ordinary research subjects in its two-pronged approach to:

1) Research studies for the purpose of establishing the theoretical foundation for policy innovation that is based on an international perspective
2) Research studies on the items which have become important issues in present-day policy-making.

The institute also implemented 4 subjects of research study using the Coordination Funds for Promoting Science and Technology.

### (2) Organization

**Figure 3-7-1. Organizational Chart**




Key:—1. Director—2. Advisors—3. Guest Research Officials—4. General Affairs Department—5. Planning Department—6. Information Systems Department—7. 1st and 2nd Research Groups—8. 1st - 4th Research Groups

The organization of the institute is shown in Figure 3-7-1.

### (3) Budget and Personnel

**Table 3-7-1. FY 1988 Budget (Unit: ¥1000)**

| Item | FY 1988 Budget Amount |
|---|---|
| 1 Expenditures for research studies | 43,622 |
| (1) Special research | 25,162 |
| (2) Ordinary research | 14,992 |
| (3) Guest research officials | 3,468 |
| 2 Information system maintenance expenditures | 10,471 |
| 3 Personnel expenditures | 182,739 |
| 4 Ordinary operational expenditures | 15,320 |
| Total | 252,152 |
| Research studies using the Coordination Funds for Promoting Science and Technology | 17,289 |
| Total | 269,441 |

The budget, as shown in Table 3-7-1, was approximately ¥250 million; including the expenditures for research studies based on the Coordination Funds for Promoting Science and Technology, the budget was ¥270 million.

As for personnel, there were 46 staff members, as shown in Table 3-7-2.

**Table 3-7-2. FY 1988 Personnel (Number of people)**

| Section | Number |
|---|---|
| Appointed positions | 1 |
| Research positions | 9 |
| Administrative positions (1) | 35 |
| Administrative positions (2) | 1 |
| Total | 46 |

### (4) Operations Summary

1) Developments in International Research Exchange

The institute carries out positive international research exchange—with research personnel and information—as the large basic policy for its management of an internationally open research institute.

During FY 1988, 4 special researchers came from the United States, Sweden, and Korea; the institute sent researchers to the United States and West Germany. In addition, the institute exchanged correspondence with the U.S. National Science Foundation and Harvard University for the purpose of research cooperation with those organizations, and prepared letters for the Massachussetts Institute of Technology (United States), Sussex University and Edinburgh University (UK). In addition, many-faceted, positive international research exchange unfolded with participation in international research conferences and the large numbers of foreign researchers who came to visit.

2) Special Research

1. Research on the development of S&T indicators

In order to get a quantitative and systematic grasp on national S&T activities, the institute prepared an S&T indicator system and uses this to get a comprehensive grasp on Japan's S&T activities and to conduct internationally comparative evaluations of those activities.

2. Research on the extended technological effects of R&D projects

The institute conducts systematic research on the contribution of R&D activities to technological developments in core fields and in related fields, and the resulting social and economic effects.

3. Research Studies on the development of creative S&T talent development programs

In order to cultivate excellent creative S&T talent, which will become the key to promoting creative S&T activities, the institute conducts investigations to confirm the trends and paths of talented scientists and engineers, and explores the conditions for developing creative dispositions, e.g., the dispositions and requisites sought after in people who engage in basic research.

4. Research studies on the comprehensive analysis of trends in S&T

In order to provide basic materials for prioritizing and improving the efficiency of R&D investments and for basic field-specific R&D planning, the institute conducts research studies to confirm trends in the technological evolution of important R&D areas. This research takes into consideration the inter-relations between technical subjects and the relations between S&T trends, on one hand, and society and the economy, on the other.

5. Research studies on international friction in S&T

The institute conducts research studies to confirm that international friction in S&T has appeared recently amidst the increasing complexity of international situations.

6. Research studies on the influence of leading-edge S&T growth on resources utilization

This research involves investigations to confirm the problems and effects of leading-edge S&T growth on the resources-utilization-related policies that should be devised in correspondence with the growth of substance/materials S&T, the life sciences, and other leading-edge S&T fields, and to investigate the effects on resources utilization from the perspective of resource conservation.

3) Ordinary Research

1. Dynamic research on national programs
2. Research on joint inter-organizational research
3. Research studies on policies for maintaining the R&D base
4. Research on the historical evolution of Japan's S&T policies
5. Research on humans and society and S&T policy-making models
6. Research studies in connection with the analysis of trends in S&T developments and on trends in leading-edge S&T developments
7. Research studies in connection with the smooth promotion of international cooperation in S&T
8. Research studies on the mid- to long-term outlook on resource utilization structures and the global environment
9. Research studies on the ideal way national resources should be to correspond with changes in values and the practical application of S&T

4) Research based on the Coordination Funds for Promoting Science and Technology

1. Investigations of the current state of R&D in software S&T and future evolutionary trends

In order to positively promote software R&D activities, the institute conducts investigations on social needs with respect to software S&T and on the state of practical application of software.

2. Basic investigations of regional S&T promotion

From the standpoint of comprehensively and effectively promoting S&T activities in Japan and working towards regional promotion, the institute conducts basic research on the actual state of regional S&T activities.

3. Joint Japan-U.S. comparative research on the distinguishing structural characteristics of R&D activities

In order to analyze the current state of Japan's S&T activities from an international point of view, the institute conducts comparative investigations of the structure of R&D activities, and searches for models of R&D activity that would enable future S&T growth in both Japan and the United States to be balanced.

4. Research on methods for evaluating the effectiveness of R&D investments

In order to develop methods for getting a quantitative grasp on the R&D effects of all industries that go beyond individual technologies and products, the institute examines the framework for facilitating the flow of R&D activities and its theoretical foundation.

5) Results of Research Studies

**Table 3-7-3. FY 1988 Results of Research Studies**

Summary of Foreign Technology Imports during FY 1987

On Preparatory Investigations of Science and Engineering Students' Job-Seeking Trends

Report on Software Science and Technology

On Trends in Subjects for Awards in Science and Technology

Basic Investigations of Regional Science and Technology Promotion

Science and Technology Lecture Series (No. 1 - No. 11)

Comparison of International Research (No. 1 - No. 3)

The results of research studies published by the National Institute for Science and Technology Policy during FY 1988 are shown in Table 3-7-3.

# Part IV. Summary of Semigovernmental Research Institutes

## Chapter 1. Japan Atomic Energy Research Institute

### (1) General Situation

The Japan Atomic Energy Research Institute (JAERI) is the comprehensive atomic energy research organization capable of resolving the atomic energy R&D issues that derive from national and international circumstances. JAERI's activities extend from basic research to developmental research and even to the multi-faceted affairs of public business activities: promoting safety research to aid in the expansion and improvement of Japan's safety regulations; conducting fusion research, by way of special atomic energy R&D projects and high-temperature engineering testing and research; producing and distributing radioisotopes; training atomic-energy-related scientists and technical staff; and managing technical information on atomic energy. During FY 1988, JAERI expanded, improved, and strengthened safety research, as short-range objectives carried over from the previous year; conducted high-temperature engineering testing and research that was focused on high-temperature gas reactors, as a mid-range developmental objective; and made progress in nuclear fusion research, as a long-range objective.

### (2) Organization, Personnel, and Budget

**Table 4-1-1. FY 1988 Budget**
**(Unit: ¥ 1000)**

| Item | Budget Amount |
|---|---|
| Revenues | |
| Government investments | 73,433,000 |
| Private investments and contributions | 300,000 |
| Revenues from nuclear power generation safety testing and other commissioned work | 6,233,652 |
| Business revenues | 1,282,763 |
| Non-business revenues | 515,536 |
| Balance-forwarded funds | 810,663 |
| Subsidies | 23,877,000 |
| Miscellaneous revenues | 136,457 |
| Total revenues | 106,589,072 |
| Expenditures | |
| Expenditures for nuclear reactors | 11,188,179 |
| Expenditures for nuclear reactor research | 7,596,882 |
| Expenditures for safety research | 9,343,556 |
| Expenditures for radiation utilization research | 2,856,233 |
| Expenditures for nuclear power generation safety testing and other commissioned work | 6,233,653 |
| Expenditures for nuclear fusion research | 22,143,287 |
| Expenditures for research support | 10,956,917 |
| Expenditures for common research | 3,441,324 |
| Expenditures for nuclear ship development operations | 7,313,130 |
| Business expenditures | 591,331 |
| Business management expenditures | 602,123 |
| General administration and management expenditures | 24,008,194 |
| Reserve funds | 305,263 |
| Total expenditures | 106,589,072 |

**Table 4-1-2. FY 1988 Personnel Numbers by Business Location and Occupation**

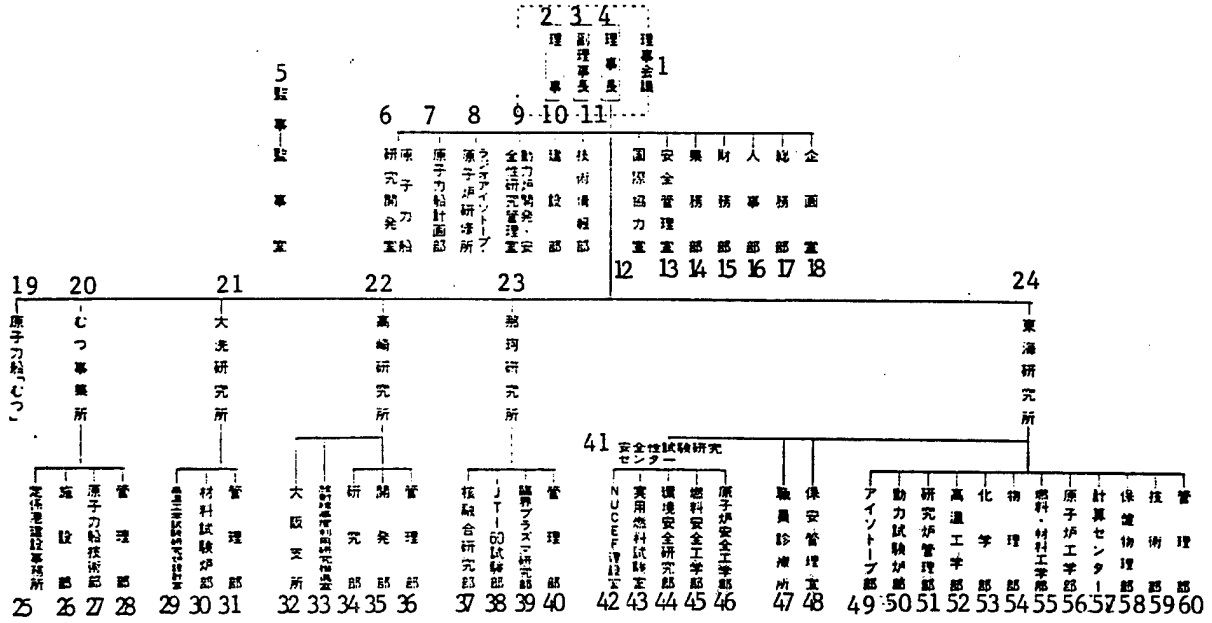
| Classification | Adminstrative | Technical Education | Technical | Research | Seamen | Total |
|---|---|---|---|---|---|---|
| Main office | 179 | 46 | 47 | 27 | - | 299 |
| Tokai Laboratory | 156 | 140 | 499 | 559 | - | 1,354 |
| Naka Laboratory | 26 | 23 | 46 | 217 | - | 312 |
| Takasaki Laboratory | 27 | 22 | 28 | 79 | - | 156 |

**Table 4-1-2. FY 1988 Personnel Numbers by Business Location and Occupation (Continued)**

| Classification | Adminstrative | Technical Education | Technical | Research | Seamen | Total |
|---|---|---|---|---|---|---|
| Oarai Laboratory | 29 | 29 | 126 | 109 | - | 293 |
| Mutsu Business Office | 12 | 28 | 13 | 11 | - | 64 |
| "Mutsu" Nuclear Ship | - | - | - | - | 38 | 38 |
| Total | 429 | 288 | 759 | 1,002 | 38 | 2,516 |

Executives: 12
Total: 2,528

**Figure 4-1-1. Organizational Chart**




Key:—1. Board of Directors—2. Directors—3. Deputy Director—4. Managing Director—5. Superintendent—6. Nuclear Ship R&D Office—7. Nuclear Ship Planning Department—8. Radioisotope and Nuclear Reactor Training Center—9. Power Reactor Development and Safety Research Management Office—10. Construction Department—11. Technical Information Department—12. International Cooperation Office—13. Safety Management Office—14. Operations Office—15. Finance Department—16. Personnel Department—17. General Affairs Department—18. Planning Department—19. "Mutsu" Nuclear Ship—20. Mutsu Operations Office—21. Oarai Laboratory—22. Takasaki Laboratory—23. Naka Laboratory—24. Tokai Laboratory—25. Port of Registry Construction Operations Office—26. Facilities Department—27. Nuclear Ship Technology Department—28. Management Department—29. High-Temperature Research Reactor Design Office—30. Materials Test Reactor Department—31. Management Department—32. Osaka Branch Office—33. Advanced Radiation Utilization Research Promotion Office—34. Research Department—35. Development Department—36. Management Department—37. Nuclear Fusion Research Department—38. JT-60 Test Department—39. Critical Plasma Research Department—40. Management Department—41. Safety Test Research Center—42. NUCEF Construction Office—43. Utility Fuels Test Office—44. Environmental Safety Research Office—45. Fuel Safety Engineering Office—46. Nuclear Reactor Safety Engineering Office—47. Employee Examination and Treatment Office—48. Security Management Office—49. Isotope Department—50. Power Test Reactor Department—51. Research Reactor Management Department—52. High-Temperature Engineering Department—53. Chemistry Department—54. Physics Department—55. Fuel and Materials Engineering Department—56. Nuclear Reactor Engineering Department—57. Computing Center—58. Health Physics Department—59. Technology Department—60. Management Department

The organization, personnel numbers, and budget for FY 1998 are shown in Figure 4-1-1, Table 4-1-1, and Table 4-1-2, respectively.

**(3) Summary of Operations**

1) Safety and Other Research

A. Engineering Safety and Other Research

Test research during FY 1988 progressed for the most part in line with Japan's Yearly Program for Safety Research in Nuclear Power Plants and Other Facilities.

Research concerning loss-of-coolant accidents involved the following activities: in connection with the ROSA-IV (Rig of Safety Assessment) program, continued experiments using the small two-phase-flow experimental facilities (TRTF) and comprehensive testing at the large transient experimental facility (LSTF); in connection with tests to demonstrate large re-flooding effects, planar and cylindrical reactor-core testing and analysis.

Fuel-related activities involved: intermittent development of FEMAX-IV code for analyzing fuel behavior during normal operations and during times of abnormal transient changes, and the maintenance of fuel behavior data files; in connection with fuel irradiation behavior, sudden output rise tests and cycle tests using the JMTR (Japan Material Test Reactor) and the BOCA; in connection with reactivity-accident-related NSRR experiments, experiments that centered on improved LWR fuels, and completing the reconstruction of facilities for irradiated fuel experiments; in connection with core damage behavior, analysis of test data that was procured from the U.S. Nuclear Regulatory Commission's SFD program and the EPRI's LACE program, and experiments on cooling characteristics of damaged cores; and continued development of analysis code.

Structure-related activities involved: crack propagation experiments in connection with the safety of reactor structures; in connection with pipeline reliability tests, instability destruction tests using stainless steel and carbon steel pipes.

Research concerning nuclear fuel facilities involved continued testing to demonstrate the safety of reprocessing facilities' cell ventilation systems. JAERI began construction of the Nuclear Fuel Cycle Safety Engineering Facilities (NUCEF), where research will involve criticality safety, after receiving permission from the prime minister to establish the facilities, and carried out the working design of the interior facilities. In connection with dry storage of spent fuel, the institute conducted intermittent air-oxidation tests.

Safety analysis code development involved the following activities: with respect to maintenance and development of reactor safety code, completion of work on the MINCS accident analysis code to prepare it for public access; in the development of a system for in-core analysis when an accident occurs, intermittent research that applies knowledge-engineering-based methods to diagnose nuclear power abnormalities in research reactors. In the development of stochastic safety assessment methods, international cooperation in benchmark testing commenced for the purpose of verifying methods with which to analyze the reliability of internal phenomena. In the field of earthquake risk assessment, the institute conducted sensitivity analyses of earthquake risks and determined the important factors. In research for assessing the safety of nuclear fuel and other facilities, the institute completed the JACS criticality safety analysis code and the RADHEAT-V4 shield safety code. Development of code for assessing the safety of reprocessing facilities also progressed.

As for post-irradiation tests of utility fuels, the institute carried out tests on fuels from the Fugen reactor (ATR) and the Osaka No 2 reactor, and on NSRR and JPOR fuels, and strove to establish technology for that testing.

Regarding international cooperation, the institute continued collaboration in the ROSA-IV, the LOFT, SFD, and TMI-2 R&D programs.

B. Environmental Safety and Other Research

JAERI's environmental safety research went according to plan and involved the following activities: measurement and evaluation of environmental radioactivity; research on the transition of radioactive nuclides throughout the environment; research on the safety of low- to mid-level radioactive-waste processing and disposal; research on the safety of TRU waste and high-level radioactive-waste processing and disposal; research on separating groups of high-level wastes and converting them to resources; and safety testing of high-level radioactive wastes. The institute also boosted the development of technology for controlling environmental radioactivity, and performed measurements and evaluations of internal and external exposure doses. Furthermore, as research using special accounts that was commissioned by the Science and Technology Agency, the institute conducted the following activities: safety verification tests to assess environmental radioactive diffusion; long-term leaching tests of low-level radioactive waste solids; tests to verify the safety of artificial barriers; tests to verify the safety of natural barriers; development of comprehensive safety assessment models; research studies on measures for TRU-waste processing and disposal; tests to verify the safety of the rational disposal of very-low-level solid wastes; investigations of aircraft radiation-survey systems for emergency use; the development of equipment for acceptance testing of reprocessed solids returned from overseas.

As for nternational cooperation, JAERI participated in the following efforts: Japan-China joint research on the safety of low- to mid-level radioactive-waste processing and disposal; joint research with the U.S. Nuclear Regulatory Commission on high-level radioactive-waste safety; analysis of the tritium open-air emission experiments with the Canadian AECL; joint research with the

U.S. Environmental Protection Agency on a pilot radiation protection standards database, the influence of residual radioactivity on physics and engineering instrumentation, re-utilization, and radon in residential environments.

2) High-Temperature Engineering Testing and Research

A. High-Temperature Engineering Testing and Research Reactor

Based on the the Atomic Energy Commission's report from the High-Temperature Gas Reactor R&D Program Experts Meeting, dated December 1986, and the Long-Term Nuclear Power Utilization Plan, dated June 1987, JAERI carried out the working design for a high-temperature engineering testing and research reactor (HTTR). The reactor will have irradiation functions; the final goal is to achieve a reactor outlet coolant temperature of 950 °C. In February 1989 the institute applied for permission to establish the reactor.

B. Research and Development

Fuel research included radiation tests of coated-particle fuels; graphite materials research included testing mechanical characteristics. Heat-resistant metals research involved the intermittent testing of the overall soundness of Hastelloy XR alloys.

Research in reactor physics involved criticality experiments in the the VHTRC (high-temperature gas reactor criticality experiment facilities) and analysis. Measurement research included the development of a high-temperature in-chain bar.

Regarding the large-structure equipment demonstration test loop (HENDEL), the institute carried out heat transmission and flow tests using the $T_1$ test section and reactor interior structure demonstration tests with the $T_2$ test section.

3) Fusion Research

JAERI's fusion research was based on plans such as the Atomic Energy Commission's Basic Plan for the Second Phase of Fusion R&D.

A. Research on Fusion Reactor-Core Plasma Technology

As for the critical plasma test device (JT-60), after achieving its objectives in the heating experiments of September 1987 (central electron density, 1.3 x $10^{20}$electrons/$m^3$; central ion temperature, 44,000,000°; product of density and confinement time, 1.8 x $10^{19}$ seconds/$m^3$), the institute conducted pellet injection tests and other research aimed at improving the performance of the Tokamak, together with modifying and preparing the JT-60 for larger electrical currents. Meanwhile, with the high-performance Tokamak development test device (JFT-2M), the institute conducted high-efficiency confinement and current drive tests. Additionally, the institute carried out research on plasma instrumentation, plasma confinement theory, and other such subjects.

B. Reactor-Core Engineering Technology and Reactor Engineering Technology Research

Reactor-core engineering research included the development of high-power negative-ion beam sources and evacuation systems. Reactor engineering research involved the following: research on superconductive coils, such as the development of a pulse poloidal coil and a large toroidal coil; reactor physics research employing neutron sources that are used in fusion reactor physics experiments (FNS); materials research on fusion materials; and irradiation research. JAERI also completed an experimental device to be used in research on tritium handling and processing technology, started hot experiments, and pursued research on tritium production technology. Furthermore, the institute carried out research on fusion reactor systems and design research for the next facilities.

As for international cooperation, JAERI took part in the following activities in joint Japan-U.S. research: the Doublet-III project; joint irradiation projects involving fusion reactor materials; engineering work involving neutrons used in the fusion reactor blanket; tritium handling technology; Tokamak experiments using a micro-pond; and joint development of negative-ion sources. JAERI also continued its participation in joint work with the International Energy Association (IEA) on three large tokamaks, the superconductive coil joint development project (LCT project), and the fusion reactor materials radiation damage R&D project. In October JAERI published a report on the LCT project, which ended in January. After April 1988, under the International Atomic Energy Association (IAEA), the institute participated with the United States, the European Community, and the Soviet Union in concept design activities for the International Thermal Fusion Experimental Reactor (ITER).

4) Nuclear Ship R&D

In accordance with the "Basic Plan for Research Needed in the Japan Atomic Energy Research Institute's Development of a Nuclear Ship" that was prescribed by the prime minister and the Minister of Transport on 31 March 1985, the institute is promoting nuclear ship R&D and research on marine reactor improvements using the "Mutsu" nuclear ship.

A. New Port Construction at Sekinehama

Regarding the harbor facilities for the "Mutsu" nuclear ship's new port of registry at Sekinehama, the institute brought the ship over from Ominato harbor in January 1988 and has been maintaining the facilities at Sekinehama. It was also working diligently, however, on the construction of auxiliary on-shore facilities as well, work

that was continued from the previous year. The entire facilities were nearly complete by the end of the fiscal year.

B. Implementing Spot Inspections, Tests, Etc.

The institute began reactor container cover release spot inspections of the "Mutsu" nuclear reactor facilities in August 1988. Since November 1988 the institute has been carrying out spot inspections and maintenance of the nuclear fuel, the interior structure of the reactor, etc., after opening the container cover for the first time in 16 years.

C. Research for Improving Marine Reactors

With a view to improve the economic characteristics and reliability of marine reactors, the institute conducted design assessment research in connection with the concept of marine reactors, and the necessary experiments and analyses for that research.

In addition, the institute carried out research on "Nuclear Ship Engineering Simulation," which analyzes the dynamic characteristics of nuclear ships in a variety of operating conditions.

D. Crew Training

Through ship maintenance work on the "Mutsu," the institute strove to improve the crew's skills in nuclear reactor plant management. JAERI also used an operations training simulator for crew training and education and dispatched crew members to in-house training courses.

E. Management of "Mutsu" Ship and Port Maintenance and Other Activities

The institute directed the management and maintenance of the "Mutsu" nuclear ship and the Ominato and Sekinehama facilities, and carried out radiation management and environmental monitoring.

5) Basic Research

A. Reactor Physics and Reactor Engineering

Using the FCA (fast criticality experiment assembly), JAERI performed experiments related to large core characteristics of fast reactors and the nuclear characteristics of high-conversion light-water reactor cores, and conducted design research on advanced reactors such as metal-fuel fast reactors and intrinsically safe light-water reactors. The institute's reactor physics and reactor engineering research also included research on nuclear reactor instrumentation, control, shielding, and systems.

B. Nuclear Fuels and Reactor Materials

JAERI pushed forward with plutonium fuels R&D and conducted periodic research on a nuclear power materials database.

C. Physics and Chemistry

Intermittent work continued in the following areas: heavy-ion nuclear physics research and neutron nuclear physics research using tandem accelerators; the maintenance of nuclear, atomic, and molecular data; radiation damage and physical characteristics of solids; actinoid chemistry research; and laser chemistry research.

D. Miscellaneous

Other efforts included research on the development of safeguards technology, the development of technology for dismantling reactors, and research on intelligent systems technology for nuclear reactors. Also, field tests continued in the dismantling of JPDR equipment.

6) Radiation Utilization Research

A. Polymer Development

These efforts involved the development of polymers with separation functionality, the development of fixing for slow-release pharmaceutical products using radiation-induced polymerization, and research on the application of cellulose waste resources in the fermentation of sugar. The institute also carried out research on radiation-resistant organic materials and on thin-layer graft polymerization.

B. Radiation Utilization Technology Development

These efforts included research on radiation processing of exhaust gases and raw waters, both from drainage waters and water supplies; sludge disinfection using radioactivity; research on composting; and research on radioactive hardening, food irradiation, and the sterilization of medical tools. The institute also took part in joint research with Indonesia and Malaysia and cooperated with developing countries in radiation utilization technology centered on the RCA.

C. Research on the Advanced Utilization of Radiation

The institute worked on the production of high-energy-ion and mid-energy-ion irradiation devices and began the construction of an ion irradiation research facility.

D. Research on Isotope Production and Utilization

In order to expand the use of new radioisotopes, the institute not only pushed forward with research on the production of tritium, organic labelled compounds, and the small-beam-source RJ medical-use accelerator, but also developed related measurement technology.

7) The Isotope Business

Net charges for the distribution of radioisotopes amounted to ¥67.002 million; the institute shipped 10 Curies of refined radioisotopes and 17,233 Curies of radiation-source isotopes during FY 1988.

8) Facilities Operations Management and Safety Management

A. Facilities Operations Management

Using fuels with mid-level uranium concentrations, the institute conducted joint-use operations of the JRR-2 for 12 cycles; the JRR-40, for 40 weeks; and the JMTR for 5 cycles. As for the reconstruction of the JRR-3, after obtaining all of the necessary construction authorization, the institute produced the reactor, the cooling system, the instrumentation and control systems, the cool neutron source, the radiation utilization equipment, and so forth. As for the JPDR, it is being dismantled.

B. Safety Management

The institute maintained the relevant safety by-laws and carried out radiation management and radioactive-waste processing in the regular facilities. The institute also revised security regulations for reactor facilities to conform with revisions to the Law on Nuclear Reactor Regulations. Furthermore, the institute held in-house meetings of the Nuclear Reactor Safety Investigations Committee that dealt with high-temperature test reactors and other reactors, and carried out safety investigations in connection with modifications made to nuclear reactor facilities.

9) Research Support and Overseas Affairs

A. Technical Information

Regarding the International Nuclear Power Information System (INIS), the institute implemented an on-line retrieval service in Japan that uses JOIS (the Japan Information Center of Science and Technology's On-Line Information System) for information searches. Of the research results published during FY 1988, there were 5 JAERI reports, 240 JAERI-M reports, and 2,655 reports from academic institutions.

B. Technical Personnel Training

The Isotope Training Department held basic courses five times; specialized courses seven times; courses for radiation-handling managers of the first category, five times; a course for environmental measurement masters of the first category, one time; and educational lecture courses two times. The Nuclear Reactor Training Department held a basic course one time; specialized courses three times; short-term invitational courses seven times; and lectures on the prevention of nuclear power disasters. Both departments also conducted one international course for developing countries.

C. Facilities Maintenance

The Tokai Laboratory carried out reactor facilities and equipment construction that accompanied the JRR-3 modifications, and finished building the next cooling tower for the experimental and utilization facilities. The laboratory also prepared sites for low- and mid-level storage facilities and the NUCEF nuclear fuel cycle safety engineering facilities.

In the Naka District, the institute completed the construction of and preparations for the west district public services area.

In the Takasaki District, the institute worked on the construction of ion irradiation research facilities.

## Chapter 2. Japan Information Center for Science and Technology

### (1) General Situation

The Japan Information Center for Science and Technology (JICST), a pivotal organization with respect to S&T information in Japan, was established in 1957. Its objective is to contribute to S&T promotion in Japan by quickly and accurately providing domestic and foreign S&T information.

As a consequence of the growth in S&T, the amount of scientific and technical information generated increases every year, and the demand for information becomes more diversified as R&D becomes more interdisciplinary. Accurate information access services that cope with such a situation are becoming increasingly important.

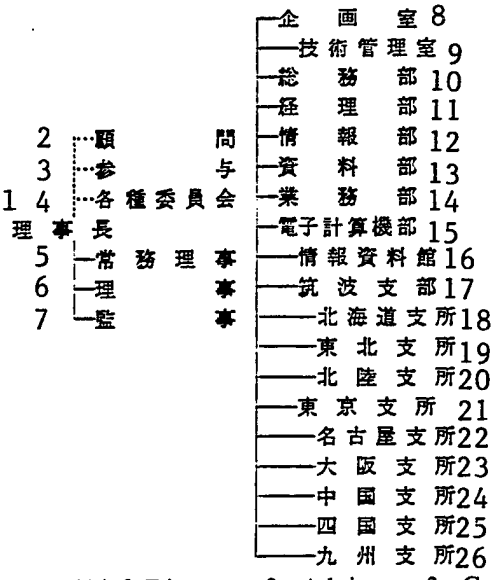
From this standpoint, the Japan Information Center for Science and Technology conducted these and other related activities during FY 1988: 1) expanding various databases, such as the JICST database; 2) promoting and internationalizing on-line services; 3) furnishing publications, e.g., providing quick documentation reports; 4) promoting internationally cooperative operations; 5) promoting the development of information processing technology.

The organization of the information center is shown in Figure 4-2-1.

### (2) Organization and Personnel

In addition to six executives and a staff of 321, JICST also commissions advisors and consultants so that the opinions of academic societies and the industrial world will influence its management. Various committees that are composed of experts from all fields are also organized within the center.

**Figure 4-2-1. Organizational Chart**




Key:—1. Chief Director—2. Advisors—3. Consultants—4. Various Committees—5. Managing Director—6. Director—7. Superintendent—8. Planning Office—9. Technology Management Office—10. General Affairs Department—11. Accounting Department—12. Information Department—13. Data Department—14. Operations Department—15. Computer Department—16. Data and Information Building—17. Tsukuba Branch Office—18. Hokkaido Branch Office—19. Tohoku Branch Office—20. Hokuriku Branch Office—21. Tokyo Branch Office—22. Nagoya Branch Office—23. Osaka Branch Office—24. Chukoku Branch Office—25. Shikoku Branch Office—26. Kyushu Branch Office

### (3) Budget

**Table 4-2-1. FY 1988 Revenues and Expenditures (Unit: ¥ 1000)**

| Revenues | Budget Amount |
|---|---|
| Government investments | 4,700,000 |
| Private investments and contributions | 51,000 |
| Subsidies from the national treasury | 2,061,000 |
| Revenues from information provision services | 4,491,760 |
| Consignment business revenues | 20,787 |
| Non-business revenues | 71,726 |
| Funds balance-forwarded from previous year | 495,172 |
| Total | 11,891,445 |
| **Expenditures** | **Budget Amount** |
| Information-base organization business expenditures | 4,719,368 |
| Consignment business expenditures | 20,787 |
| Expenditures for facilities maintenance | 100,000 |
| Expenditures for information provision services | 4,161,222 |
| General administration and management expenditures | 2,886,557 |
| Reserve funds | 3,511 |
| Total | 11,891,445 |

The revenues and expenditures for FY 1988 are shown in Table 4-2-1.

### (4) Summary of Operations

JICST's operations are divided into three large areas: information gathering, information processing, and furnishing information.

1) Information Gathering

A. Collection

1. Foreign Serial Publications During FY 1988, JICST collected 6,079 varieties of foreign serial publications relating to the physical sciences, engineering, and medicine.

2. Domestic Serial Publications

During FY 1988, the center collected 6,274 varieties of domestic serial publications relating to the physical sciences, engineering, and medicine.

3. Special Data from Overseas, Etc. The center collected 761 different presentations, papers, and other materials from all countries in which conferences were held.

B. Clearing Services

1. JICST sent questionnaires to 575 research organizations from which it received 504 replies. It combined this data with data from 95 organizations that was included in the "National Research Operations Plan" of the Science and Technology Agency's Science and Technology Policy Bureau, created an index, updated the previous year's files, and then organized S&T research information files to include 17,260 subjects of on-going research (599 organizations).

2. The center collected 3,480 varieties of public data that was published by government-related organizations, local public groups, and other such organizations; summarized the data; and created 4,017 database entries.

2) Information Processing

A. Document Database Creation

After being processed, the first set of collected data was stored as "JICST Scientific and Technical Document Files" and other types of files on magnetic tape (database); this data is used in on-line information retrievals and commissioned retrievals.

Table 4-2-2 shows the numbers of information items processed during FY 1988.

**Table 4-2-2. Numbers of Information Items Processed**

| Classification | Foreign Documents | Japanese Documents | Total |
|---|---|---|---|
| Chemistry and chemical engineering (foreign) | 156,241 | | 156,241 |
| Mechanical engineering | 50,895 | 18,979 | 69,874 |
| Electrical engineering | 29,784 | 21,491 | 51,275 |
| Metal engineering, mining engineering, and earth sciences | 40,066 | 10,455 | 50,521 |
| Civil and construction engineering | 16,999 | 19,178 | 36,177 |
| Physics and applied physics | 52,801 | 7,471 | 60,272 |
| Management and systems technology | 21,752 | 8,575 | 30,327 |
| Chemistry and chemical engineering (Japanese) | | 40,095 | 40,095 |
| Environmental pollution | 11,333 | 3,215 | 14,548 |
| Energy | 21,423 | 2,402 | 23,825 |
| Subtotal | 401,294 | 131,861 | 533,155 |
| Japanese medical | | 62,937 | 62,937 |
| Total | 401,294 | 194,798 | 596,092 |

B. Organizing the Quick Reports of S&T Literature

The center automatically formats "Quick Reports of S&T Literature" and indexes this information by author, magazine, and keyword.

C. English Database Operations

The center created an English database of 196,780 Japanese documents from JICST S&T document files and JICST Japanese medical document files.

D. Fact Database Operations

1. JICST created the following five kinds of databases.
   a. Mass spectra: 1,376 database entries from the 1,689 data items collected and organized.
   b. Thermal properties of matter: 6,714 database entries from the 5,024 data items collected and organized.
   c. Crystal structures: 1,565 data items created.
   d. Metals: 2,615 fatigue and creep test data items created.
   e. Legal regulations: 2,474 data items created.

2. The center introduced a DNA database and a mass spectra database.

3. The center converted 69,622 items of chemical compound dictionary data into a database.

4. The center created programs for handling information about crystal structures and metals, and started a DNA information service.

3) Providing Information

A. Publications Service

1. Quick-Reports of S&T Literature

JICST publishes 12 series of "Quick-Reports of S&T Literature," as shown in Table 4-2-3.

**Table 4-2-3. Quick-Reports of S&T Literature**

| Classification | Publication Frequency | Volumes Sold |
|---|---|---|
| Chemistry and chemical engineering edition (foreign editions) | Every ten days (36 volumes) | 841 |
| Mechanical engineering edition | Twice every month (24 volumes) | 703 |
| Electrical engineering edition | " | 762 |
| Metal engineering, mining engineering, and earth sciences edition | " | 499 |
| Civil and construction engineering edition | " | 390 |
| Physics and applied physics edition | " | 429 |

**Table 4-2-3. Quick-Reports of S&T Literature (Continued)**

| Classification | Publication Frequency | Volumes Sold |
|---|---|---|
| Nuclear energy engineering edition | Once every month (12 volumes) | 180 |
| Management and systems technology edition | " | 395 |
| Chemistry and chemical engineering edition (Japanese editions) | " | 1,132 |
| Environmental pollution edition | " | 534 |
| Energy edition | " | 275 |
| Life sciences edition | Twice every month (24 volumes) | 561 |
| Total | | 6,701 |

Incidentally, each series contains both Japanese and foreign literature, but JICST publishes separate foreign and domestic editions for the field of chemistry.

2. Quick-Reports of Foreign Patents (Chemical Edition)

JICST assigns Japanese titles and publishes the weekly "Quick-Reports of Foreign Patents, Chemical Edition."

3. Overseas Technology Highlights

JICST publishes a monthly summary of interesting news, articles about general outlooks, new product introductions, S&T trends in other countries, statitistical data, and so forth.

4. Miscellaneous

Other publications include "Information Management" and "A Guide to Subjects in Public Research Organizations."

B. Service Consignments

**Table 4-2-4. Numbers of Service Consignments**

| Content of Services | FY 1988 Consignments |
|---|---|
| Reproduction services | 1,204,226 cases |
| Translation services | 9,615 cases |
| Investigation services | 318 cases |
| Consigned retrieval services | 7,118themes |

The information center carried out consigned services to answer specific orders from individual users. Table 4-2-4 shows the numbers of service consignments during FY 1988.

C. On-line Information Services

**Table 4-2-5. State of On-line Information Service Usage**

| Name of System | Numbers of Queries, Connect-Time |
|---|---|
| JOIS | 916,592queries |
| JOIS-F | 1,886queries |
| STN | 22,511 hours |

JICST's on-line information retrieval services used the JOIS, JOIS-F (fact database system), and the STN (international S&T information network) systems. System usage during FY 1988 is shown in Table 4-2-5.

**(5) Development of Information Processing Technology**

1) Standardization of Information Distribution

A. Drawing Up Standards Proposals

The center drew up SIST13, "Index Creation" (proposal).

B. Standards Confirmation

The center conducted a questionnaire survey to confirm SIST02, "Reference Document Formats."

C. Holding Dissemination and Explanation Meetings

The center held meetings to disseminate and explain information about standards in the cities of Takamatsu, Toyama, Kyoto, and Tokyo.

2) Developing an Advanced Database System

The center carried out the detailed design of an advanced database system in which: 1) batch jobs are processed on the host, and 2) processing jobs are allocated amongst work stations. The center also designed programs for a process management system.

3) JOIS-III Development

A. The center wrote programs for the JOIS-III system and made preparations to launch services.

B. The center maintained and managed a database deposit system.

C. As for the STN, the center used the basic and peripheral software, and purchased communications management equipment for the upgraded version of Messenger that accompanied the introduction of electronic mail.

4) Machine Translation System Maintenance

A. Utility-Scale Dictionary Creation

1. Creation of Japanese-English Translation Dictionaries

The information center created a 100,000-word analysis dictionary, a 100,000-word conversion dictionary, and a 167,000-word generative dictionary within a dictionary of indeclinable parts of speech; and a 9,000-word analysis dictionary, a 9,000-word conversion dictionary, and a 3,500-word generative dictionary within a terminology dictionary.

B. Japanese-English Machine Translation System Development

1. Grammar Rules

The information center modified the grammar rules of the system based on the results of evaluations of the translation process and on sample sentences used in evaluations.

2. Programs to Support the Creation and Modification of Grammar Rules

The center wrote programs for those parts of the existing software that had to be modified.

3. Translation Program

The center wrote the translation execution program.

4. Translation Dictionary Creation and Management System

The center wrote programs for TSS-based (time share system) updates and created medical translation dictionaries.

**(6) Computer System The center has been working at automating its information processing since FY 1967. Currently, at the end of FY 1988, the following systems are in operation.**

| | |
|---|---|
| Batch Systems: Article file creation system | Article editing system<br>Terminology management system<br>Clearing information system |
| On-Line Systems: S&T document retrieval system (JOIS-II) | International S&T information network (STN International)<br>Data management system<br>JICST fact database system (JOIS-F) |

In connection with on-line systems, the center started actually running the JOIS-II service in April 1981 and is now in the process of developing the JOIS-III system, which is scheduled to come on-line in the middle of FY 1989.

In addition, the center provides services for the international S&T information network (STN International), which was built in cooperation with the Chemical Abstracts Service (United States) and FIZ-Karlsruhe (West Germany).

Furthermore, the center provides on-line access to its fact databases (JOIS-F).

**(7) Exchange and Cooperation with Domestic and Foreign Information Organizations**

JICST strove to advance Japanese information activities: it cooperated closely with Japanese and foreign S&T-information-related organizations, exchanged ideas, and carried out joint operations. The center's efforts to strengthen international harmony and exchange involved attendance at major international conferences of relevance.

1) Domestic Cooperation

JICST engaged in vigorous information activities in cooperation with the Chemical Information Association, the Japan Iron and Steel Association, the Small Business National Corp. (the Small Business Information Center), the Central Medical Publications Group, the Japan Agricultural Library Council, the Japan Atomic Energy Research Institute, the Ministry of Construction's Public Works Research Institute, and other Japanese organizations.

2) International Cooperation

In keeping with the internationalization of S&T information, JICST collaborated with foreign information organizations, attended international conferences, investigated S&T information activities abroad, etc.

A. Exchange and Cooperation with Overseas Information Organizations

JICST cooperates periodically with the Korean Industrial Research Institution (KIET) and the Bulgarian CISTI, and accepts foreign trainees from KIET and other groups. It also attended the general assembly of the ICSTI (France) and the STN Management, Review, and Technology Meetings, and shared information with information-related organizations of each country.

B. Information Activities in Europe

Based on the memorandum on cooperation with France's CNRS/INIST, JICST established a representative office in Paris and has been carrying out information activities there; it has accepted one INIST member at the center.

C. ASCA Cooperation in S&T Information Affairs

1. JICST distributed 8,165 English abstracts of Japanese documents (agriculture, forestry, and fisheries production; energy technology; electronics and communication) to ASCA (Association for Science Cooperation in Asia) countries.

2. The center published the 1988 English-language research subject magazine, the source of which was the file on domestic research subjects from FY 1987, and distributed the magazine in ASCA countries.

### (8) Work Commissioned by the Government

1) Research on the Development of a Prototype Materials Evaluation Database for International Use

The center organized sub-committees composed of experts from fields such as materials and information, investigated topics in data distribution, and conducted preparatory studies on trends in European and U.S. materials databases.

2) Development of Interface Technology to Support Chemical Property Design

JICST implemented, according to plan, the development of a 3-dimensional chemical structure display system that uses the chemical compound dictionary database.

3) Investigations in connection with the Demonstration of a Botanical Genetic Resources Information System

JICST built the system model needed in the construction of a database that primarily contains information about the locations of botanical genetic resources preserved by preservation organizations of various fields.

## Chapter 3. Institute of Physical and Chemical Research

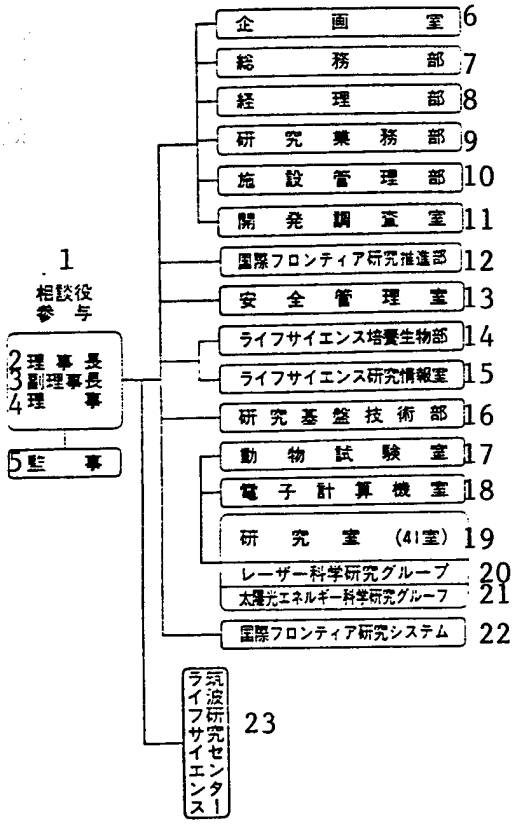
### (1) General Situation

The Institute of Physical and Chemical Research (RIKEN), whose parent was the foundation with the same name that was established in 1917, was a joint stock corporation for a short period after the war, then was restarted as a special corporation in 1958 by the enactment of the Institute of Physical and Chemical Research Act.

RIKEN functions as an integrated research organization; its horizontal structure covers a wide range of scientific fields, its vertically layered connections serve to facilitate the practical application of basic research. The institute contributes to developments in broad academic and industrial arenas by extending its research results through means such as publishing documents and data and holding symposiums as well as by approving patent licenses and accepting researchers and trainees at the institute.

### (2) Organization

**Figure 4-3-1. Organizational Chart**




Key:—1. Advisors and Consultants—2. Managing Director—3. Deputy Director—4. Directors—5. Superintendent—6. Planning Office—7. General Affairs Department—8. Accounting Department—9. Research Operations Department—10. Facilities Management Department—11. Development Investigations Office—12. International Frontier Research Promotion Office—13. Safety Management Office—14. Life Sciences Cultures Biological Department—15. Life Sciences Research Information Office—16. Research Base Technology Department—17. Animal Tests Office—18. Computer Lab—19. Research Labs (41)—20. Laser Science Research Group—21. Solar Energy Science Research Group—22. International Frontier Research System—23. Tsukuba Research Center, Life Sciences

The organization of the institute is shown in Figure 4-3-1.

### (3) Budget and Personnel

In the budget for FY 1988, priority was given to life science projects, the construction of an accelerator for heavy-ion science, and the maintenance of systems for promoting frontier research.

**Table 4-3-1. FY 1988 Budget: Yearly Business Revenues and Expenditures (Unit: ¥ 1000)**

| Revenues | | Expenditures | |
|---|---|---|---|
| Item | Budget Amount | Item | Budget Amount |
| Investments Category | | | |
| | (9,527,000) | | (4,655,488) |
| Government investments | 9,742,000 | Expenditures for research operations | 4,774,521 |
| Private investments and contributions | 139,000 | | |
| | | | (1,501,018) |
| | | Expenditures for life science research promotion | 1,549,403 |
| | | | (1,302,759) |
| | | Expenditures for general cooperative research promotion affairs | 1,336,222 |
| | | | (110,413) |
| Business revenues | 1,065,872 | Operations management expenditures | 111,588 |
| | (63,575) | | (3,265,287) |
| Miscellaneous revenues | 64,004 | Facilities construction and maintenance expenditures | 3,278,499 |
| | | | (2,130) |
| Funds balance-forwarded from previous year | 41,648 | Management facilities expenditures | 2,291 |
| | (10,837,095) | | (10,837,095) |
| Subtotal | 11,052,524 | Subtotal | 11,052,524 |
| Subsidies Category | | | |
| | (6,395,390) | | (6,441,383) |
| Subsidies from the national treasury | 6,292,000 | General management expenditures | 6,325,241 |
| | (45,993) | | (0) |
| Miscellaneous revenues | 44,964 | Reserve funds | 11,723 |
| | (6,441,383) | | (6,441,383) |
| Subtotal | 6,336,964 | Subtotal | 6,336,964 |
| | (17,278,478) | | (17,278,478) |
| Total | 17,389,488 | Total | 17,389,488 |

Figures within parentheses are for the budget that was approved after changes were made.

Table 4-3-1 gives a summary of the budget. At the end of FY 1988, the institute's total capital was ¥84,789,107,800.

As for personnel, six new employees joined the institute and six people left during FY 1988, for a total of 619 individuals (seven executives), of which 442 were research staff.

### (4) Summary of Operations

1) Facilities Construction and Maintenance Activities
Facilities maintenance work that was continued from the year before included the construction of an accelerator for use in heavy-ion science, the Tsukuba life sciences research facilities, and pollution safety facilities. The institute also carried out construction of a central research and experimentation building and a building for aging experiments, which are facilities for frontier research promotion.

2) Test Research Activities

A. Equipping and Expanding the Research System

RIKEN expanded its organization for the construction of the heavy-ion-science accelerator and made provisions for the life sciences research system—in particular, research promotion in the Tsukuba district. The institute also made preparations for promoting comprehensive joint research (Frontier Research).

Furthermore, RIKEN furnished and maintained equipment that it provides for joint use in each of its research labs and implemented the development of leading-edge basic research.

B. Research Subjects

1. General Research

Implementation of pioneering, fundamental research that extends over physics, chemistry, biology, and other fields.

2. Laser Science Research

Implementation of research and other activities related to laser heavy-isotope separation.

3. Solar Energy Science Research

Implementation of research and other activities related to photosynthesis science.

4. Special Research

a. Nuclear-Power-Related Research

- Nine research subjects in addition to research on super-heavy elements and new unstable isotopes

b. Radiation Research

- Fundamental research for the purpose of technical investigations of radiation

c. New Biological Control Science Research

- Elucidating control mechanisms at the biomolecular level and at the cell/individual level and research in connection with the creation of new biological control techniques

d. New Reaction Site Chemistry Research

- Research on elucidating the mechanisms of new reaction site chemical reactions and applications thereof

e. New Superconductors Research

- Research on the creation of new high-temperature superconductive oxides and the production of new devices

5. Industrialization Research

The development of isotope-selective silicon films

6. International Joint Research

Research on improved surface quality and physical properties using ECR (Electronic Cyclotron Resonance) plasmas

7. Subsidized and Commissioned Research

a. Subsidized Research

During FY 1988, RIKEN carried out research on the correlation between enhancer functions of human H-ras genes and carcinogenesis, and 59 other research subjects.

b. Commissioned Research

During FY 1988, RIKEN was entrusted with 34 research projects in addition to research on techniques for analyzing and evaluating high-performance materials using new beam technology.

3) Dissemination of Research Results

A. Research Publications

In addition to publishing its papers in Japanese and foreign scientific journals, RIKEN also puts out publications that it distributes domestically and abroad: "Reports from the Institute of Physical and Chemical Research" (in Japanese) and "Scientific Papers of the Institute of Physical and Chemical Research" (in English).

RIKEN also publishes the "Annual Report of the Institute of Physical and Chemical Research," "Laser Science Research," "Catalog of Published Research Papers from the Institute of Physical and Chemical Research" (in Japanese), and the "RIKEN Accelerator Progress Report" (in English). Incidentally, the "1987 Catalog of Published Research Papers from the Institute of Physical and Chemical Research" included over 390 papers.

RIKEN held 33 physics symposiums during FY 1988.

B. Industrial Property Applications and Registrations

1. Applications

The number of applications for patent inventions during FY 1988 and the number of applications that are currently pending at the end of FY 1988 are as follows.

| | | |
|---|---|---|
| Japanese patent applications: | 825 | (of which 116 were filed in FY 1988) |
| Foreign patent applications: | 283 | (of which 97 were filed in FY 1988) |
| Utility model applications: | 47 | (of which 9 were filed in FY 1988) |
| Total | 1,155 | (of which 222 were filed in FY 1988) |

2. Registrations

The number of patents currently held at the end of FY 1988 are shown in Table 4-3-2.

Table 4-3-2.

| Category | Number held at end of FY 1987 | Number registered | Less expirations | Less those discontinued | Number held at end of FY 1988 |
|---|---|---|---|---|---|
| Japanese patent rights | 507 | 48 | -3 | -32 | 520 |
| Foreign patent rights | 237 | 21 | -8 | -1 | 249 |
| Utility model rights | 21 | 2 | -1 | -2 | 20 |
| Design rights | 1 | 0 | 0 | 0 | 1 |

C. Patent Rights and Other License Approvals

At the end of FY 1988, the institute concluded 70 license approval contracts (183 related patent rights) with 47 private companies and received approximately ¥107.13 million in royalty revenues during the fiscal year.

D. Other Commissioned Work

1. Commissioned Research (Including Commissioned Testing, Technical Guidance, and Joint Research)

During FY 1988, RIKEN conducted commissioned research and testing and provided technical guidance on 94 subjects from 94 companies; it received approximately ¥292.284 million in revenues from commission fees for this work.

2. Consigned Researchers

Based on contracts with private companies and other organizations, RIKEN accepted 142 researchers from 138 companies and took in approximately ¥146.90 million in revenues from commission fees during FY 1988.

3. Commissioned Analysis and Other Work

RIKEN conducted organic micro-chemical analyses, cyclotron radiation, and other commissioned work, for which it received approximately ¥17.38 million during FY 1988.

4. Selling Microorganisms

RIKEN received approximately ¥9.17 million in revenues from selling microorganisms.

5. Sales of Manufactured Research Articles

RIKEN received approximately ¥20.250 million in revenues from sales of manufactured research articles.

E. Technology Development Promotion

1. Trial Products

Because trial products are judged to be essential to commercial production, RIKEN produced the following four types of trial products during FY 1988.

i) anti-fungal antibiotic phosphazomycin trial products
ii) internal stress measurement equipment
iii) laser-based C-13 carbon dioxide trial products
iv) information transfer mechanisms for samples in sample-transport devices

B. Approaching Companies

1. Publishing the "Institute for Physical and Chemical Research News" (six times per year)

2. Making the Most of Various Groups

RIKEN asked the Research Development Corporation of Japan to lend their good offices to help settle matters related to patents held by the institute.

C. Technical Advising

RIKEN strove to solve technical and scientific problems by accepting the advice of companies and other groups and by gaining the cooperation of researchers.

4) Promotion of Life Sciences Research

During FY 1988, RIKEN carried out the following activities.

A. Implementing investigations and studies for the purpose of efficiently and systematically promoting life science project research and research support operations

B. Promotion of Project Research

- development of new technology for utilizing microbiological organisms
- research on systems for exploring and developing genetically manifested source products in nervous systems
- research on systems for exploring and developing genetically manifested source products in immune systems
- analytical research on human chromosomes and genes

C. Promotion of Research Operations

- implementing genetic S&T research

  implementing research to evaluate the safety of new recombinants
  implementing research on the genetics of human cancer
  implementing research on the analysis of genetic manifestation mechanisms in human retroviruses

D. Promotion of Research Support Operations

For the purpose of efficiently promoting life sciences research, RIKEN examined the life-sciences-related research data maintenance project, the experimental animal development project, the program to implement the preservation of microbiological strains, and other plans, and carried out the following activities.

- development of information systems in various fields: experimental animals, microbiology, seaweeds, animal and plant cultivation, cytology, and botany
- development of experimental animals
- microbiological strains preservation and selling microorganisms
- collecting and preserving cells and genes

5) Promotion of Comprehensive Joint Research (Frontier Research)

- implementing research on bio-homeostasis
- implementing research on frontier materials
- implementing research on thought functions

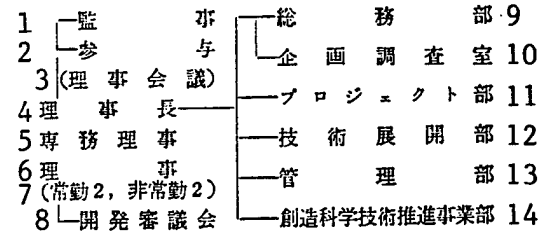
## Chapter 4. Research Development Corporation of Japan

### (1) General Situation

The Research Development Corporation of Japan was established on 1 July 1961 under the provisions of the the Research Development Corporation of Japan Law (1961, Law No 82).

This business group facilitates the commercialization of new technology by commissioning S&T development that is important to the nation's economy but is new technology that is extremely difficult to commercialize. It conducts the basic research that becomes the parent for promoting the Creative S&T Promotion System, a system in which exploratory research oriented towards the creation of original, innovative technological seeds is conducted within a fluid research system. Furthermore, in addition to actively disseminating the results of these research efforts, the group also lends their good offices in settling development matters that have to do with useful new technology.

**Figure 4-4-1. Organizational Chart**




Key:—1. Superintendent—2. Consultants—3. (Board of Directors)—4. Managing Director—5. Executive Director—6. Directors—7. (2 full-time, 2 part-time)—8. Development Council—9. General Affairs Department—10. Planning and Research Office—11. Project Department—12. Technological Development Department—13. Management Department—14. Creative S&T Promotion Affairs Department

### (2) Organization

The Research Development Corporation of Japan maintained its system so that it could efficiently further its development operations, which are expanding every year.

Table 4-4-1 shows the organization of the Research Development Corporation of Japan during FY 1988.

### (3) Budget and Personnel

1) Investments and Capital

The entire amount of the Research Development Corporation of Japan's capital is financed by the government, as prescribed in Article 5 of the Research Development Corporation of Japan Law. During FY 1988, investments amounted to ¥4.719 billion; capital, ¥44.482637 billion.

2) Budget

**Table 4-4-1. FY 1988 Budget: Yearly Business Revenues and Expenditures (Unit: ¥ 1000)**

| Revenues | |
|---|---|
| **Item** | **FY 1988 Budget Amount** |
| Investments Category | |
| Government investments | 4,830,000 |
| Recovered development expenses | 3,758,645 |
| Recovered expenses for expediting influence | 29,980 |

**Table 4-4-1. FY 1988 Budget: Yearly Business Revenues and Expenditures (Unit: ¥ 1000) (Continued)**

| | |
|---|---|
| **Revenues** | |
| Business revenues | 515,392 |
| Non-business revenues | 69,366 |
| Funds balance-forwarded | 411,384 |
| Sub-total | 9,614,767 |
| Subsidies Category | |
| Subsidies from the national treasury | 731,000 |
| Non-business revenues | 10,667 |
| Sub-total | 741,667 |
| Total | 10,356,434 |
| Expenditures | |
| Item | FY 1988 Budget Amount |
| Investments Category | |
| [Development consignment contract limit] | [5,200,000] |
| Development expenditures | 4,957,633 |
| Expenditures for development operations | 155,766 |
| Expenditures for disseminating development results | 157,722 |
| Expenditures for influence operations | 177,136 |
| Expenditures for expediting influence | 40,000 |
| Expenditures for research operations | 3,815,967 |
| Expenditures for leading-edge research results development operations | 208,927 |
| Facilities management expenditures | 1,616 |
| Reserve funds | 100,000 |
| Sub-total | 9,614,767 |
| Subsidies Category | |
| General management expenditures | 741,070 |
| Reserve funds | 597 |
| Sub-total | 741,667 |
| Total | 10,356,434 |

Revenues and expenditures for the Research Development Corporation of Japan during FY 1988 are shown in Table 4-4-1.

3) Personnel

There were seven executives and 76 staff members at the end of FY 1988.

### (4) Content of Operations

New technology development operations carried out by the Research Development Corporation of Japan are separated into the following four large areas.

- Commissioning businesses with the development of new technology that is extremely difficult to commercialize. (commissioned development of new technology)
- Conducting basic research that involves searching for knowledge about early-stage technology that will contribute to the creation of new technology. (creative S&T promotion operations)
- Disseminating the results of new technology development and basic research.
- Use of influence in settling new technology development matters.

1) Commissioned Development of New Technology

**Table 4-4-2.**

| Subject Name | Commissioned Enterprises |
|---|---|
| Technology for producing tungsten mono-crystals | Tokyo Tungsten Co., Ltd. |
| Multi-directional X-type erection bars and technology for manufacturing the bars | Nagatani Industrial Corp. |
| Technology for producing high-density sintered silicon carbide | Sumitomo Cement Co., Ltd. |

**Table 4-4-2. (Continued)**

| | |
|---|---|
| Technology for producing high-purity multi-crystal cubic boron nitride | Denki Kagaku Kogyo K.K. |
| Technology for manufacturing high-performance optical isolators | Namiki Precision Gems Co., Ltd. |
| Technology for manufacturing GaAs mono-crystals using vapor-pressure control techniques | Mitsubishi Metals Corp. |
| Technology for manufacturing integrated semiconductor pressure sensors | Toyoda Machine Works, Ltd. |
| Brain activity analysis equipment | Chuo Electronics Co., Ltd. |
| Technology for manufacturing microprocessors for fuzzy inference applications | Omron Tateishi Electronics Co. |
| Technology for manufacturing high-strength optical films for use in ultraviolet lasers | Canon Inc. |
| Technology for producing high-quality graphite | Matsushita Electronic Products Corp. |
| Stable carbon-13 isotope enrichment technology using laser techniques | Nippon Steel Chemical Co., Ltd. |
| | Nippon Steel Corp. |
| Technology for manufacturing electrostatically capacitant hygroscopic elements | Kurabe K.K. |

There were 313 items of new technology whose development was completed or which were under development at the end of FY 1988; development consignment contract fees amounted to ¥76.5 billion. Of these, the development of 255 new technology items was complete by the end of FY 1988 (of which 226 were successful and 25 were not); for most of the items, production had already been implemented by each business. There were 13 cases of new technology development for which new contracts were drawn up in FY 1988. The limit on commissioned development was ¥5.2 billion. (Table 4-4-2)

2) Successful Development Subjects during FY 1988

**Table 4-4-3.**

| Subject Name | Commissioned Enterprise |
|---|---|
| DNA base analysis device | Seiko Electronic Industries, Ltd. |
| Mass-division refining system for biologically-related polymers | Kokyu K.K. |
| High-resolution electronic-energy-loss spectrograph | Eiko Engineering K.K. |
| Technology for manufacturing cobalt-nickel alloy thin-film magnetic disks | Hitachi Metals Ltd. |
| Low-voltage non-volatile semiconductor memory (NVRAM) | Seiko Electronic Industries, Ltd. |
| Technology for manufacturing fine powders for use in non-oxide ceramics | Nihon Cement Co., Ltd. |
| Technology for manufacturing multi-colored electroluminescent elements | Fujitsu Ltd. |
| Technology for producing phosphazen flame-retardants | Nippon Soda Co., Ltd. |
| Technology for manufacturing auxiliary high-speed semiconductor memory | Citizen Watch Co., Ltd. |

Table 4-4-3 shows the 1988 developments that were successful.

3) Effectivating and Disseminating the New Technology that was Developed

As mentioned above, from the time of its inauguration to the end of FY 1988, the Research Development Corporation of Japan completed the development of 255 items of new technology, of which 226 were recognized as succesful. Each of the businesses associated with the successful technologies have either implemented production or are making the necessary preparations for production. 4) Influence in Settling New Technology Matters

The Research Development Corporation of Japan conducted 579 studies and assessments of patent rights (including pending applications) held by national research institutes, universities, and other public organizations.

During FY 1988, the Research Development Corporation of Japan acted on behalf of 76 companies with respect to 62 subjects, using its influence to settle matters

concerning privately submitted applications for patent rights and matters of patents rights which it had not settled at the end of the previous fiscal year. As a result, it helped to settle 464 matters for 579 companies.

5) Creative S&T Promotion Operations

An outline is given in Part 1, Chapter 5.

6) Leading-Edge Research Result Development Operations

The purpose of these operations is to foster new technology related to the basic research results brought forth by creative S&T promotion operations, national research institutes, universities, and so forth. These operations were started in FY 1986; the general idea is to conduct development tests using developmental test groups in which researchers and several different businesses participate (high-tech consortium groups), and to establish peripheral patents.

These efforts during FY 1988 involved the implementation of four subjects that included "Organic Non-Linear Optical Materials" and "High-Temperature Superconductive Materials" were implemented during FY 1988.

## Chapter 5. Power Reactor and Nuclear Fuel Development Corporation

In accordance with the Basic Nuclear Energy Act (1955, Law 186) and the Power Reactor and Nuclear Fuel Development Corporation Act (1967, Law 73), the purpose of the Power Reactor and Nuclear Fuel Development Corporation (PNC) is to facilitate the development and utilization of nuclear energy: to systematically and efficiently conduct the independent development of fast breeder reactors and advanced thermal conversion reactors; to produce, reprocess, and store nuclear fuel substances; and to explore for nuclear fuels and prepare the ores.

For the "Joyo" fast experimental reactor, the PNC carried out rated operations in the irradiation core (MK-II core with an output of 100 MW).

As for the "Monju" fast breeder reactor, the PNC applied for permission from the prime minister to establish the reactor in December 1980 and obtained the consent of the local people to build the facility in May 1982. During a Cabinet meeting on 14 December 1982, the fact that the PNC was going to expedite the construction of the "Monju" reactor came to be appreciated. Soon afterwards, a second safety investigation was begun by the Nuclear Safety Commission and permission to establish the reactor was granted by the prime minister on 27 May 1983. Since then, the PNC has been applying for "Authorization of Facilities and Construction Methods," in conformity with the Nuclear Reactor Regulatory Law, and for "Authorization of Construction Design," in accordance with the Electrical Enterprises Act.

On the other hand, after January 1983 the PNC was making preparations for the construction of the Monju power plant facilities—site preparations and the construction of shifting channels, approach roads, and revetments.

Starting with excavation for the foundation, construction of the facilities commenced on 25 October 1986 after permission related to the Natural Public Parks Act was obtained and a construction validation notice was received.

The reactor containment vessel was completed in April 1987 and the reactor vessel was installed in October 1988.

As for advanced thermal conversion reactors, intermittent operations of the "Fugen" reactor proceeded smoothly, resulting in a 72.1% facility utilization factor in FY 1988. 20 March 1989 marked the ten-year anniversary since the start of "Fugen" operations. From the start of those operations until the end of March 1989, the reactor generated a total of nine billion kWH and its facility utilization factor was 62.7%.

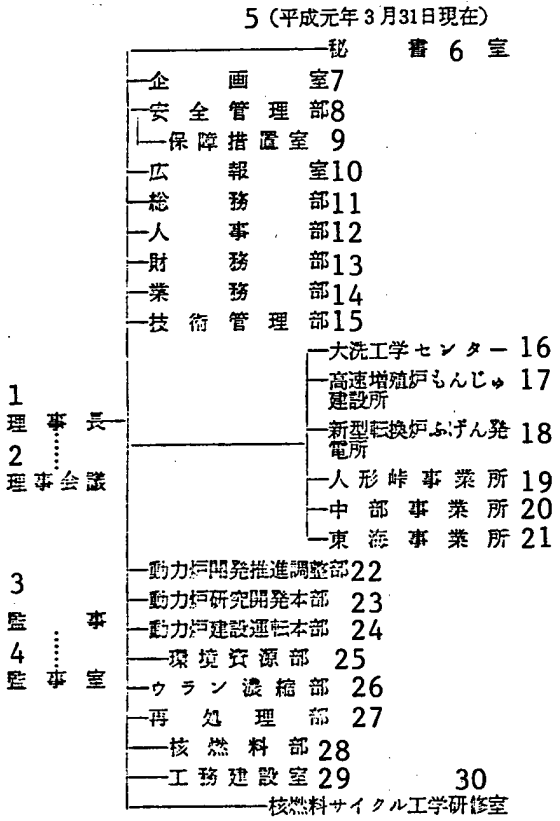
In connection with exploration for raw nuclear materials, the PNC probes for uranium resources in Japan and abroad, and conducts recovery technology and exploration technology R&D.

Regarding uranium enrichment, pilot plant operations continued intermittently and the DOP-1 prototype plant started operations in April 1988. The PNC completed the DOP-2 prototype plant in January 1989 and began trial operations. As for centrifuge development, from FY 1987 to FY 1990, ten electric companies and the Japan Nuclear Fuel Production Company are collaborating in research on the development of a high-performance centrifuge that incorporates new materials.

Furthermore, the PNC initiated the development of molecular-laser-based uranium enrichment technology. As for the reprocessing of spent fuels, the PNC has been carrying out necessary maintenance of the Tokai reprocessing plant since the planned suspension of operations there in June 1988. Incidentally, by the end of FY 1988, the Tokai plant reprocessed approximately 392 tons of fuel.

(2) Organization

**Figure 4-5-1. Organizational Chart**




Key:—1. Managing Director—2. Board of Directors—3. Superintendent—4. Superintendent's Office—5. (31 March 1989)—6. Secretaries' Office—7. Planning Office—8. Safety Management Department—9. Safeguards Office—10. Public Relations Office—11. General Affairs—12. Personnel Department—13. Finance Department—14. Operations Department—15. Technology Management Department—16. Oarai Engineering Center—17. "Monju" FBR Construction Office—18. "Fugen" ATR Power Plant—19. Ningyo Toge Operations Office—20. Chubu Operations Office—21. Tokai Operations Office—22. Power Reactor Development Promotion Coordination Department—23. Power Reactor R&D Main Office—24. Power Reactor Construction and Operations Main Office—25. Environmental Resources Department—26. Uranium Enrichment Department—27. Reprocessing Department—28. Nuclear Fuels Department—29. Engineering Contractors Office—30. Nuclear Fuel Cycle Engineering Studies Office

The main changes made to improve the organization during FY 1988 are as follows.

1) Headquarters

A. Setting up the Nuclear Fuel Cycle Engineering Studies Office (1 April 1988)

The PNC set up this office, whose important affairs encompass the entire company, so that it can enforce training and education within a coherent responsibility system that covers everything from planning to implementation. Importance is attached to training and education that centers on on-site practice and drilling, company personnel training, and study programs for foreign engineers from developing countries, as a part of the large amounts of technology transfer that are expected now and in the future.

2) Operations Offices

A. Setting up the Labor Section at the "Monju" FBR Construction Office (1 April 1988)

While omitting nothing in dealing with the personnel, labor, health, and welfare affairs that accompanied the personnel increase at the "Monju" site, which will be entering into the phase of full-scale on-site construction, the PNC set up this section so that it could strengthen labor safety measures for the increasing number of construction workers.

B. Setting up the Plutonium Fuels Equipment Section the Tokai Plant (1 April 1988)

As the third-to-be-developed plutonium-fueled FBR comes on line (FY 1988), the maintenance of equipment and facilities will increase tremendously. Furthermore, with the increased automation of equipment and facilities, more advanced maintenance technology is demanded together with the greater than normal upkeep needed to sustain a higher rate of facilities operations. Consequently, the PNC set up the Plutonium Fuels Equipment Section for the purpose of promoting preventative maintenance measures to accommodate these circumstances.

C. Setting up the Production Technology Maintenance Section at the Ningyo Toge Uranium-Enrichment Plant (1 November 1988)

Although ten years of non-interrupted operations is planned for the uranium-enrichment prototype plant (DP), the upkeep of peripheral facilities, starting with the $UF_6$ supply system, is essential to that achievement. Another objective for the DP operations is to link the performance record of maintenance activities with the establishment of maintenance technology for optimal plant operations.

With this in mind, the PNC used the completion of the second operational unit (DOP-2) installation as an opportunity to set up a maintenance section in the Uranium-Enrichment Production Technology Department. The purpose of this section is to achieve the uranium-enrichment activities mentioned above without any errors.

(3) Personnel and Budget

During FY 1988, the staff increased by 9 (a loss of 28 employees and a gain of 37 new employees). At the end of FY 1988, there were 11 executives (in addition to 3 part-time directors) and a staff of 2,832.

**Table 4-5-1. FY 1988 Budget**
**(Unit: ¥ million)**

| Revenues | | Expenditures | |
|---|---|---|---|
| **Investments Category** | | | |
| | | Expenditures for FBR development | * 63,234 |
| Investments | 134,364 | | 85,494 |
| Government investments | 114,164 | Expenditures for ATR development | * 60 |
| | | | 12,690 |
| Private investments and contributions | 20,200 | Common expenditures for power reactor development | * 2,101 |
| | | | 17,731 |
| Loans | 41,700 | Expenditures for reprocessing facilities | * 6,308 |
| | | | 40,938 |
| Business revenues | 27,750 | Expenditures for reprocessing development | * 18,501 |
| | | | 21,505 |
| Non-business revenues | 759 | Expenditures for exploration development | 3,647 |
| Funds balance-forwarded | 598 | Expenditures for fuels development | 1,684 |
| | | Expenditures for uranium enrichment | * 1,004 |
| | | | 19,716 |
| | | Expenditures for general management | 1,307 |
| | | Reserve funds | 458 |
| Subtotal | 205,170 | Subtotal | * 84,840 |
| | | | 205,170 |
| **Subsidies Category** | | | |
| Subsidies | 23,931 | Expenditures for general management | 23,997 |
| Non-business revenues | 106 | Reserve funds | 30 |
| Subtotal | 24,026 | Subtotal | 24,026 |
| Total | 229,197 | Total | * 84,840 |
| | | | 229,197 |

* Liability

### (3) Content of Operations

1) Power Reactor Development

A. FBR Development

The "Joyo" fast experimental reactor underwent its 7th periodic inspection, and the PNC conducted rated operations of its radiation core (the MK-II core with a thermal output of 100 MW).

Construction of the "Monju" FBR progressed smoothly during FY 1988; currently, at the end of March 1989, the overall rate of progress is 65.1%.

In civil engineering work, construction of the screen pump room is being completed and on-site preparation is continuing.

As for building construction, interior concrete work on the reactor building was intermittent, and construction of an external shield wall commenced. Up to the first aboveground floor of the reactor's auxiliary building was completed. The first underground floor of the maintenance/waste-processing building was completed, and the highest floors of the bodies of the turbine building and diesel building were nearly finished.

In connection with the authorization of facilities and construction methods, the main authorization had been granted during FY 1987.

On the other hand, the PNC is carrying out FBR R&D that involves reactor physics, instrumentation, systems, fuels, structural materials, and safety-related activities. Activities at the Oarai Engineering Center involved the following: mock-up testing of the reactor-body structural

equipment and cooling system equipment; in connection with fuel and structural materials R&D, post-irradiation testing of irradiated spent fuel and materials from the "Joyo" reactor, the JMTR and, overseas reactors; development of high-temperature structural design methods; testing the compatibility of materials and sodium in in-air and in-sodium materials tests.

Safety-related R&D involved the following: sodium-water reaction tests, comprehensive steam generator safety tests, sodium transient boiling tests, fuel failure propagation tests, and post-accident decay-heat removal tests.

As for activities that involved international cooperation, in reactor physics R&D, the PNC worked on the analysis of the JUPITER experiment, in which it participated with the United States and the ANL. In safety R&D, the PNC took part in reactivity-accident trial in-pile tests (CABRI) and large-scale in-pile safety tests (SCARABEE in-pile test) in France.

In addition to conducting research on key technology that is aimed at reducing the costs of facilities, the PNC also carried out research on heterogeneous reactor cores and other reactor physics research related to large reactors. Also, the "FBR R&D Management Committee," which is comprised of the PNC, JAERI, the Japan Atomic Power Company, and the Chugoku Electric Power Company, held meetings on large reactor R&D issues.

B. ATR Development

Operations of the "Fugen" prototype reactor continued intermittently during FY 1988; the utilization rate for the year was 72.1%. The PNC carried out the seventh periodic inspection of the reactor from April to July and replaced 30 pieces of fuel. Four of the pieces of MOX (mixed oxide) fuel that were replaced were plutonium that had been extracted from reprocessed spent fuel from the "Fugen," thereby closing the ATR nuclear fuel cycle loop. Also, 39 pieces of fuel were replaced during the planned 1988 shutdown in January.

With the objectives of improving performance, minimizing exposure, and making an impact on demonstration reactors, prioritized "Fugen" R&D involved: operation code improvements, development of operational maintenance and inspection equipment, and post-irradiation testing at the close of surveillance tests of fuel retrieved from the "Fugen" and pressure tube materials.

As for demonstration reactors, the PNC carried out R&D that involved: assessments and studies for the purpose of using the performance record and R&D results of "Fugen" operations to create an effect on demonstration reactors; safety and instrumentation system R&D; trial fuel assembly production; and irradiation testing.

2) Nuclear Fuels Development

A. Uranium Resources: Operations, Mining, and Development

1. Overseas

In work continued from the previous year, the PNC investigated ore deposits, carried out joint studies, and investigated the mining industry situation.

Investigations of ore deposits involved research in the Sekile region of the Republic of Niger in Africa and in the Margarock region of Australia.

Joint studies involved investigating the Kariba Lake region of Zimbabwe in Africa, the Done Lake and Princess Mary regions of Canada, the Jian Chang region of China, and West Pine Creek region of Australia.

2. Domestic

At the Ningyo Toge plant, the PNC operated smelting conversion facilities and shipped $UF_6$ to the uranium-enrichment pilot plant; the $UF_6$ obtained from conversion tests of reprocessed recovered uranium.

Other R&D activities included uranium-ore processing tests.

At the Chubu Operations Office, R&D activities included the development of exploration technology such as impress reaching technology and remote sensing analysis technology.

Uranium exploration studies in Japan also involved managing exploration data at the completion of exploration activities and drafting reports.

B. Plutonium Fuels Development

The PNC produced mixed plutonium-uranium oxide fuels for use as replacement fuels in the "Fugen" prototype ATR and the "Joyo" fast demonstration reactor, and conducted irradiation tests, safety assessments, mixed conversion tests, and the development of plutonium-utilization technology.

The FBR fuel production technology development facilities started producing "Joyo" replacement fuels in October 1988 after going through plutonium testing. Construction work continued on facilities for producing ATR demonstration reactor fuels. The plutonium nitrate conversion facilities operated intermittently; the mixed oxide powders obtained provided replacement fuels for the "Joyo" and "Fugen" reactors and initial loading fuel materials for the "Monju" reactor.

C. Fast Reactor Fuel Reprocessing Development

As development oriented towards the advancement of technology for fast reactor fuel reprocessing, the PNC conducted R&D activities in areas such as pre-processing procedures, main separation procedures, emissions reduction, materials, telemetry, and analysis

instrumentation. The PNC also carried out laboratory-scale reprocessing tests in the high-level radioactive substance research facilitiesusing irradiated fuel pins from the Joyo and Tokai fast reactors.

In addition, the PNC started the detailed design of facilities for recycling equipment testing.

D. Waste Measures, Etc.

The PNC is working on across-the-board technology development—from processing to storage to disposal—for dealing with high-level, TRU, BΓ, and uranium waste products. As for high-level waste products, they are using vitrification engineering test equipment and mock-up test equipment for testing long-term operational performance, remote manipulation characteristics, maintenance characteristics, special operational characteristics of molten glass liquification, etc. In March 1988, preliminary construction commenced on the vitrification technology development facilities. The start of hot trial runs is scheduled for FY 1991.

The PNC worked on the general design of a storage plant for waste solids. Research on disposal centered on performance evaluations that theoretically illustrate long-term safety assurance arrangements using a wide variety of barrier systems.

As for TRU waste products, the PNC is conducting demonstration tests in connection with TRU waste processing in solid waste preprocessing facilities and in plutonium waste processing and development facilities.

E. Uranium Enrichment Development

Construction of the prototype plants at Ningyo Toge progressed in two stages: the DOP-1, where operations commenced in April 1988; and the DOP-2, where trial runs were started after its completion in January 1989.

Uranium-enrichment testing is continuing intermittently at the pilot plant.

As for centrifuge development, the PNC has been collaborating with ten electric power companies and the Japan Nuclear Fuels Industry Company in joint research that started in FY 1986 and will continue until FY 1991. The purpose of the research is to expedite the actual use of a high-performance centrifuge that incorporates new materials. After completing system tests that gave a firm grasp of the basic characteristics of cascading using the centrifuge, the groups finished the production of a block test device for gaining plant-scale cascade design data, and have been carrying out tests.

In cooperation with the Institute for Physical and Chemical Research, the PNC started engineering demonstration tests of uranium enrichment using molecular laser methods.

3) Reprocessing The PNC reprocessed 19.0 tons of fuel during FY 1988, starting with the reprocessing in January 1988 (88-1 Campaign). With this, the total amount of spent fuel processed from September 1977, when the Tokai plant started hot tests, until March 1989 was 392.4 tons.

## Chapter 6. National Space Development Association

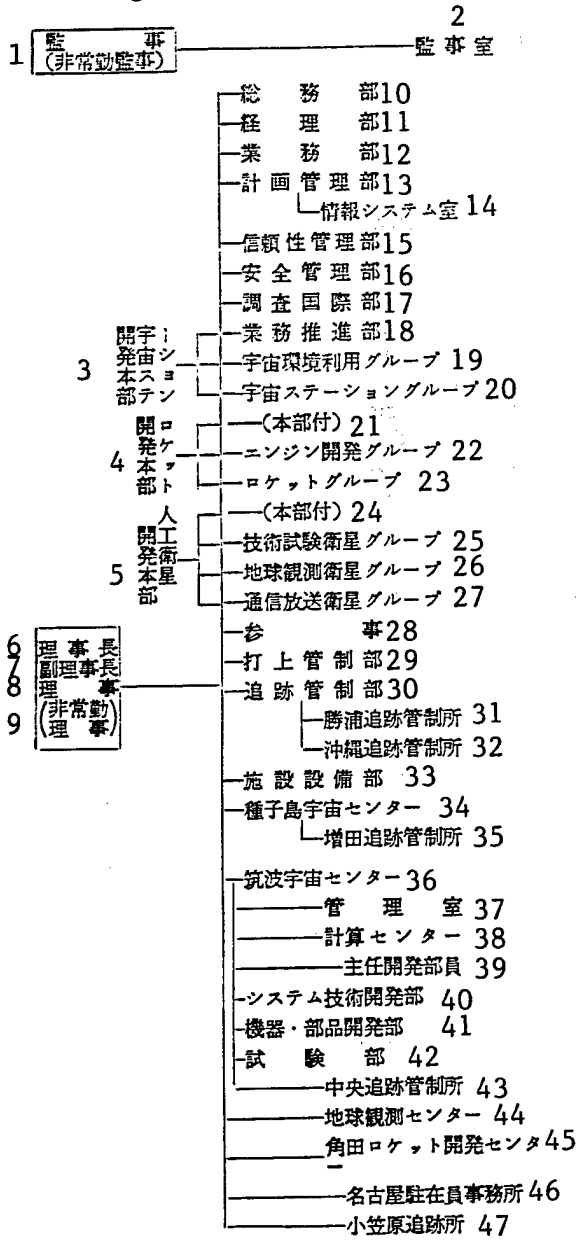
### (1) General Situation

The National Space Development Association (NASDA) was established on 1 October 1969 as Japan's core organization for space development. It continues the work of the Ionized Layer Sounding Satellite Development Departments of the former Space Development Promotion Headquarters and the Ministry of Posts and Telecommunications' Electric Wave Research Institute (now the Comprehensive Communications Research Institute).

NASDA operations are based on the "Basic Space Development Program" that was prescribed by the prime minister. Activities during FY 1988 included the launching of the "Sakura 3-b" communications satellite from an H-I rocket in September 1988.

(2) Organization

Figure 4-6-1. Organizational Chart




Key:—1. Superintendent (Part-time Superintendent)—2. Superintendent's Office—3. Space Station Development Headquarters—4. Rocket Development Headquarters—5. Satellite Development Headquarters—6. Managing Director—7. Deputy Director—8. Directors—9. (Part-time Directors)—10. General Affairs Department—11. Accounting Department—12. Operations Department—13. Program Management Department—14. Information Systems Office—15. Reliability Control Department—16. Safety Management Department—17. Investigations and International Department—18. Operations Promotion Department—19. Space Environment Utilization Group—20. Space Station Group—21. (attached to the headquarters)—22. Engine Development Group—23. Rocket Group—24. (attached to the headquarters)—25. Technology Test Satellite—26. Earth Observation Satellite—27. Communications Broadcast Satellite—28. Councilors—29. Launch Control Department—30. Tracking Control Department—31. Katsuura Tracking Control Station—32. Okinawa Tracking Control Station—33. Facilities and Equipment Department—34. Tanegashima Space Center—35. Masuda Tracking Control Station—36. Tsukuba Space Center—37. Management Office—38. Computing Center—39. Manager Development Staff—40. Systems Technology Development Department—41. Instrumentation and Equipment Development Department—42. Test Department—43. Central Tracking Control Station—44. Earth Observation Center—45. Kakuda Rocket Development Center—46. Nagoya Residents' Office—47. Ogasawara Tracking Station

**Table 4-6-1. FY 1988 Budget: Business Revenues and Expenditures**
**(Unit: ¥ 1000)**

| | |
|---|---|
| **Revenues Section** | |
| Investments Category | |
| Investments | 87,563,000 |
| Business revenues | 16,258,307 |
| Non-business revenues | 805,297 |
| Funds balance-forwarded | 53,614 |
| Sub-total | 104,680,218 |
| Subsidies Category | |
| Subsidies | 8,971,000 |
| Non-business revenues | 49,559 |
| Sub-total | 9,020,559 |
| Totals | |
| Total | 113,700,777 |
| Government Expenditures | 87,563,000 |
| Investments | 8,971,000 |
| Subsidies | 96,534,000 |
| **Expenditures** | |
| Investments Category | |
| Expenditures for satellite development | 29,985,000*<br>16,941,013 |
| Expenditures for comprehensive promotion of space environment utilization | 10,329,680*<br>8,343,653 |
| Expenditures for rocket development | 48,567,200*<br>44,911,220 |
| Expenditures for rocket launching and facilities construction | 18,389,200<br>11,358,971* |
| Expenditures for tracking and control | 1,360,700*<br>6,647,054 |
| Expenditures for construction of Tsukuba Space Center facilities | 3,991,200*<br>11,528,094 |
| Expenditures for processing earth observation information | 1,954,723 |
| Expenditures for operations management | 2,637,718 |
| Expenditures for general management | 157,722 |
| Reserve funds | 200,000 |
| Sub-total | 112,622,980* |
| | 104,680,218 |
| Subsidies Category | |
| Expenditures for general management | 9,016,763 |
| Reserve funds | 3,796 |
| Sub-total | 9,020,559 |
| Totals | |
| Total | 112,622,980*<br>113,700,777 |
| * Liability | |

Table 4-6-1 shows the revenues and expenditures of the budget for FY 1988. The budget was approximately ¥113.7 billion; this was about ¥1.2 billion less than the ¥114.9-billion budget for FY 1987. At the end of FY 1987, the NASDA had 11 executives (of which there were two part-time directors and one part-time superintendent) and 938 staff members.

### (4) Summary of Operations

1) Satellite Development

NASDA continued the development of the No 3-b communications satellite (CS-3b), the No 4 geostationary weather satellite (GMS-4), the No 3 broadcast satellites (BS-3a and BS-3b), the No 1 earth resources

satellite (ERS-1), and the type-VI engineering test satellite (ETS-VI). NASDA started the new development of the No 1-b marine observation satellite (MOS-1b) and the No 5 geostationary meteorological satellite (GMS-5), and R&D work on the earth observation platform engineering satellite (ADEOS).

2) Comprehensive Promotion of Space Environment Utilization

Because of its participation in the space station program, which is a joint international effort involving Japan, the United States, Europe, and Canada, NASDA put together the preliminary design for the space-station-attachment-type experimental module (JEM) and carried out other such tasks. NASDA also continued the development of equipment that is to go on board the space experiment and observation free-flyer (SFU—Space Flyer Unit), which is a joint project with the Ministry of Education's Institute of Space and Astronautical Science and MITI.

Furthermore, NASDA is continuing the development of on-board equipment for the First Material Tests (FMPT), which are material tests and other experiments using the space shuttle. It also started the development of on-board equipment for its participation in the First International Microgravity Laboratory (IML-1) that the United States is carrying out.

3) Rocket Development

NASDA developed the H-I rocket, which has the capacity for launching 550-kg geostationary satellites. The H-I is used for launching the No 3-b communications satellite (CS-3b), the No 4 geostationary weather satellite (GMS-4), the No 3 broadcast satellites (BS-3a and BS-3b), and the No 1 earth resources satellite (ERS-1). NASDA is also modifying the rocket so that it can launch the No 1-b marine observation satellite.

In addition to the H-I rocket, NASDA initiated the development of the No 1 and No 2 test machinery for the H-II rocket, which has the capacity to launch 2-ton geostationary satellites.

4) Satellite and Rocket Launches

NASDA launched the No 3-b communications satellite (CS-3b) from the No 2 H-I rocket (3-stage).

5) Tracking and Control

NASDA tracked a variety of satellites and developed tracking and control software.

It also maintained the facilities at the Katsuura and other tracking and control stations.

6) Tsukuba Space Center Maintenance

NASDA maintained facilities and equipment for satellite testing and R&D, and conducted research on guidance and control systems.

7) Earth Observation Center Maintenance

NASDA directed the reception and processing of earth observation information and maintained the facilities and equipment for processing that information.

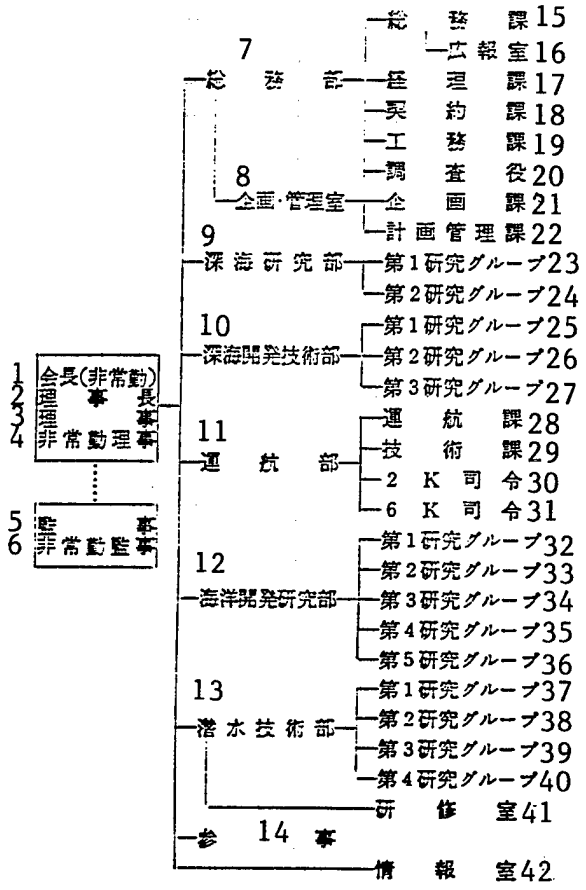
## Chapter 7. Japan Marine Science and Technology Center

### (1) General Situation

The private sector proposed the establishment of the Japan Marine Science and Technology Center as a core organization whose purpose is to comprehensively promote marine S&T through the combined efforts of government, the private sector, and the academic world. The center was set up with government and private funds on 1 October 1971.

(2) Organization

Figure 4-7-1. Organizational Chart




Key:—1. Chairman of the Board of Directors—2. Managing Director—3. Directors—4. (Part-time Directors)—5. Superintendent—6. Part-time Superintendent—7. General Affairs Department—8. Planning and Management Department—9. Deep-Sea Research Department—10. Deep-Sea Development Technology Department—11. Operations Department—12. Marine Development Research Department—13. Diving Technology Department—14. Councilor—15. General Affairs Section—16. Public Relations Office—17. Accounting Section—18. Contracts Section—19. Engineering Works Section—20. Investigations Section—21. Planning Section—22. Project Management Section—23. 1st Research Group—24. 2nd Research Group—25. 1st Research Group—26. 2nd Research Group—27. 3rd Research Group—28. Operations Section—29. Technology Section—30. 2 K Commander—31. 6 K Commander—32. 1st Research Group—33. 2nd Research Group—34. 3rd Research Group—35. 4th Research Group—36. 5th Research Group—37. 1st Research Group—38. 2nd Research Group—39. 3rd Research Group—40. 4th Research Group—41. Training Office—42. Information Office

(3) Budget and Personnel

Table 4-7-1. FY 1988 Budget: Business Revenues and Expenditures
(Unit: ¥ 1000)

| Revenues Section | |
|---|---|
| (Investments Category) | 8,957,160 |
| (Section) Investments | 8,473,433 |
| (Item) Government investments | 7,913,000 |
| (Item) Private investments and contributions | 560,433 |
| (Section) Business revenues | |

**Table 4-7-1. FY 1988 Budget: Business Revenues and Expenditures (Unit: ¥ 1000) (Continued)**

| | |
|---|---|
| Business revenues | 452,828 |
| (Section) Non-business revenues | 30,125 |
| (Item) Interest on deposits | 28,000 |
| (Item) Miscellaneous revenues | 2,125 |
| (Section) Funds balance-forwarded | |
| (Item) Funds balance-forwarded | 774 |
| (Subsidies Category) | 1,414,227 |
| (Section) Subsidies | 1,404,000 |
| (Item) Subsidies from the national treasury | 1,364,000 |
| (Item) Private contributions | 40,000 |
| (Section) Non-business revenues | |
| (Item) Miscellaneous revenues | 10,227 |
| Total | 10,371,387 |
| Expenditures | |
| (Investments Category) | 8,957,160 |
| (Section) Expenditures for developmental research operations | 8,950,860 |
| (Item) R&D expenditures | 5,617,388 |
| (Item) Expenditures for common research | 465,128 |
| (Item) Expenditures for business management | 2,813,117 |
| (Item) Expenditures for construction of common and other facilities | 25,950 |
| (Item) Expenditures for site maintenance | 29,277 |
| (Section) Expenditures for facilities | |
| (Item) Expenditures for facilities | 6,300 |
| (Subsidies Category) | 1,414,227 |
| (Section) Expenditures for general management | 1,400,224 |
| 1. Personnel expenditures | 1,198,344 |
| (Item) Expenditures for executive and staff salaries | 1,010,603 |
| (Item) Common expenditures | 178,155 |
| 2. Special expenditures | 201,880 |
| (Item) Expenditures for general management | 201,308 |
| (Item) Expenditures for entertainment | 572 |
| (Section) Reserve funds | |
| (Item) Reserve funds | 14,003 |
| Total | 10,371,387 |

1) Table 4-7-1 shows the revenues and expenditures of the budget for FY 1988.

2) At the end of FY 1988, the center had 148 employees.

**(4) Summary of Operations**

1) Main Operations

As a comprehensive, core organization involved in the development of the seas, the center conducts extensive R&D in marine S&T, shares its experimental facilities, trains researchers and engineers, and other such activities. The content of its main operations is as follows.

A. Implementing Comprehensive R&D that Requires the Cooperation of Numerous Departments and Disseminating the Results

The center strives to disseminate the results of the R&D that it promotes—efforts related to technology that is commonly required in all the wide-ranging fields of S&T for marine development, and to pioneering technology for which prompt promotion of R&D is strongly demanded.

The research fields that the center deals with include the following:

1. R&D of general technology for deep-sea development
2. R&D of general technology for human activities in the oceans
3. R&D of general technology for utilizing coastal sea areas
4. R&D of general technology for utilizing ocean energy
5. R&D of general marine observation technology
6. Marine S&T research studies

B. Maintaining, Managing, and Sharing Large Experimental Facilities

The center maintains a variety of large experimental research facilities and equipment for common use in conducting all kinds of R&D related to marine S&T. The center shares these facilities with government, private, and academic people engaged in marine S&T R&D activities.

C. Implementing Marine S&T Training and Studies

The center, having established training courses in diving and marine engineering, endeavors to cultivate the skills and talents of researchers and engineers who pursue marine development.

D. Gathering and Providing Information and Data

The center's marine S&T information activities include creating information and materials in which marine S&T trends are recorded and providing clearing services.

2) Operations during FY 1988

During FY 1988, the center conducted R&D activities in comprehensive marine S&T development projects, provided training, gathered and provided information, and maintained the equipment and facilities that become the foundation for its operations.

As R&D operations, it implemented "Deep-Sea Research Submersible R&D," "R&D of Technology for Deep-Sea Operations," "Ocean Utilization Technology R&D," and "Marine Observation Technology R&D."

Also, as general research operations, the center carried out joint research with external organizations, commissioned research, and research studies, in addition to its special and normal research.

The center used the "Shinkai 2000" deep-sea research submersible system to conduct investigations in the Sagami Bay, the Suruga Bay, the Okinawa Trough, the Japan Sea, and in the Izu-Ogasawara marine areas. The center also used the "Kaiyo" undersea operations experimental vessel to conduct joint studies with China on the Kuroshio (Black Current) and with France on the rift systems in the South Pacific.

So that it can carry out more efficient deep-sea surveys, the center employed the "Dolphin 3K" 3,300-meter unmanned probe. Additionally, it is continuing work from the previous year to build the "Shinkai 6300" research submersible and its supply ship, the "Hadesuka", and carried out the basic design for a 10,000-meter-class unmanned probe.

In connection with diving technology, the center made progress in the "New Seatopia Program," in which actual underwater experiments are carried out in depths of up to 300 meters with the "Kaiyo" undersea operations experimental vessel. The "Kaiyo" should be a way to establish 300-meter diving technology.

The center also continued training operations and information affairs from the previous year.

## Appendices

### Maintaining Legislation

Table 1 shows the laws concerning the Science and Technology Agency that were generated during FY 1988.

**STA-Related Laws Generated during FY 1988**

| Name of Law | Date Announced | Law Number | Content |
|---|---|---|---|
| Organization-related | | | |
| Office of the Prime Minister's Law that Partially Revises Organizational Regulations for the Science and Technology Agency | 8 April 1988 | Office of the Prime Minister Law No 20 | Established a new R&D base coordination official in the R&D Promotion Division of the Science and Technology Promotion Bureau, a new space transport research coordinator in the Space Activities Planning Division of the R&D Bureau, and a new nuclear safeguards administrator in the Nuclear Safety Bureau. |
| Office of the Prime Minister's Law that Partially Revises Organizational Regulations for the National Aerospace Laboratory | 8 April 1988 | Office of the Prime Minister Law No 21 | A reorganization that involved combining the 1st and 2nd Aerodynamics Sections into the Aerodynamics Section, combining the 1st and 2nd Airframe Sections into the Airframe Section, and reorganizing the Instrumentation Section into the Control Section. |
| Office of the Prime Minister's Law that Partially Revises the Organizational Regulations for the National Research Institute for Metals | 8 April 1988 | Office of the Prime Minister Law No 22 | An overall reorganization of the Research Department, it set up the Basic Properties Research Department and the Functional Characteristics Research Department and entrusts the director of the institute with establishing research groups. |

**STA-Related Laws Generated during FY 1988 (Continued)**

| Name of Law | Date Announced | Law Number | Content |
|---|---|---|---|
| Office of the Prime Minister's Law that Partially Revises the Organizational Regulations for the National Institute of Radiological Sciences | 8 April 1988 | Office of the Prime Minister Law No 23 | Did away with the Pharmaco-Chemistry Research Department and established the new Pharmacology Research Department. |
| Office of the Prime Minister's Law that Partially Revises the Organizational Regulations for the National Research Center for Disaster Prevention | 8 April 1988 | Office of the Prime Minister Law No 24 | Converted the Nagaoka Snow Damage Experimental Laboratory into the Nagaoka Snow and Ice Disaster Prevention Experimental Laboratory, the Shinjo Branch Office into the Shinjo Snow and Ice Disaster Prevention Experimental Laboratory, the Hiratsuka Branch Office into the Hiratsuka Marine Disaster Prevention Experimental Laboratory, and maintained inter-departmental research operations. |
| Cabinet Law that Partially Revises the Science and Technology Agency Organizational Law | 21 June 1988 | Cabinet Law No 207 | Terminated the National Institute of Resources and newly established the National Institute for Science and Technology Policy. |
| Organizational Regulations for the National Institute for Science and Technology Policy | 1 July 1988 | Office of the Prime Minister Law No 39 | Prescribed the internal organization of the National Institute for Science and Technology Policy, including the General Affairs, Planning, and Information Systems Divisions and other research groups. |
| Office of the Prime Minister's Law that Partially Revises the Organizational Regulations for the National Aerospace Laboratory | 31 March 1989 | Office of the Prime Minister Law No 16 | Removed the Flight Experiments Administrator position. |
| Atomic-Energy-Related | | | |
| Office of the Prime Minister's Law that Partially Revises the Legislation Enforcement Regulations relating to the Prevention of Radiation Damages due to Radioisotopes and other Radioaactive Substances | 17 May 1988 | Office of the Prime Minister Law No 29 | For the purpose of attaining the problem-free prevention of radiation damages due to the handling of radioisotopes and other radioaactive substances, the law maintained regulations for device certification of indicated radioisotope equipment and instrumentation. |
| Office of the Prime Minister's Law that Partially Revises Legislation Enforcement Regulations relating to the Prevention of Radiation Damages due to Radioisotopes and other Radioaactive Substances | 18 May 1988 | Office of the Prime Minister Law No 30 | Converted radioactivity units to international units and changed the equivalent dose limits. |
| Law to Partially Revise Regulatory Laws for Nuclear Raw Material and Nuclear Fuel Substances and Nuclear Reactors | 27 June 1988 | Law No 69 | Made the PNC, refiners, and processors responsible for safeguards to protect specific nuclear fuel substances. |
| Office of the Prime Minister's Law that Partially Revises Regulations concerning the Operation and Establishment of Reactors Provided for Test Research Use | 26 July 1988 | Office of the Prime Minister Law No 41 | Underwent radioactive unit and terminology revisions and equivalent dose limit revisions, and maintained the required regulations. |
| Cabinet Law Governing the Maintenance of Relevant Cabinet Laws Accompanying the Enforcement of Legislation to Partially Revise Laws concerning the Control of Nuclear Raw Material and Nuclear Fuel Substances and Nuclear Reactors | 27 September 1988 | Cabinet Law No 281 | Executed the required revisions, such as regulating safeguards where necessary and revising the content of specially designated nuclear fuel substances. |
| Regulations for Nuclear Fuel and Nuclear Fuel Substance-Contaminated Waste Management Enterprises | 7 November 1988 | Office of the Prime Minister Law No 47 | Stipulated items published in authorization application forms for waste management enterprises. |
| Office of the Prime Minister's Law that Partially Revises the Office of the Prime Minister's Law that Partially Revises the Regulations concerning the Operation and Establishment of Reactors Provided for Test Research Use | 22 November 1988 | Office of the Prime Minister Law No 48 | Underwent radioactive unit and terminology revisions and equivalent dose limit revisions, and maintained the required regulations. |
| Office of the Prime Minister's Law that Partially Revises the Regulations Governing the Transport of Nuclear Fuel and other Radioactive Substances Outside of Plants and Business Locations | 24 November 1988 | Office of the Prime Minister Law No 49 | The application of these regulations with respect to the transport of specific nuclear fuel substances outside of plants. |

**STA-Related Laws Generated during FY 1988 (Continued)**

| Name of Law | Date Announced | Law Number | Content |
|---|---|---|---|
| Office of the Prime Minister's Law that Partially Revises the Office of the Prime Minister's Law Governing Notification when Nuclear Fuel Substances are Transported | 24 November 1988 | Office of the Prime Minister Law No 50 | Executed the maintenance of regulations from the perspective of safeguarding specific nuclear fuel substances. |
| Cabinet Law that Partially Revises the Law Enforcing the Legislation Governing the Control of Nuclear Raw Material and Nuclear Fuel Substances and Nuclear Reactors, and to Partially Revise the Law Enforcing Regulations related to the Prevention of Radiation Damages due to Radioisotopes and other Radioaactive Substances | 22 March 1989 | Cabinet Law No 62 | Attendant upon the enactment of the Consumption Tax Act, this law raised inspection, authorization, and other fees. |
| Law to Partially Revise the Law on Compensation for Nuclear Power Damages | 31 March 1989 | Law No 21 | Raised the amount of compensation from ¥10 billion to ¥30 billion, and extended the length of time for which regulations are applicable in connection with the settlement of nuclear pwer damages compensation indemnity contracts and other contracts. |

## Budgets

### 1. FY 1988 Budget

The budget for FY 1988 was put together during the 122th session of the Diet. In the general accounts budget of the Science and Technology Agency, expenditures amounted to ¥340.41 billion and the amount of the National Treasury debt liability limit was ¥140.925 billion. This represented an increase of ¥6.736 billion over the initial budget from the previous fiscal year, an increase of ¥13.667 billion over the revised supplementary budget from the previous fiscal year, and an increase of ¥1.572 billion in the amount of the National Treasury debt liability limit. Expenditures grew by 2.0% (in comparison with the initial budget from the previous year).

As the Science and Technology Agency's share of special accounts for promoting the development of electric power resources, ¥95.083 billion for expenditures and ¥79.41 billion as the amount of the National Treasury debt liability limit was budgeted. In the special accounts for industrial investment, ¥4.7 billion was earmarked for investments in the Japan Information Center for Science and Technology. The total expenditures in the combined accounts was ¥440.19 billion, a decrease of ¥7.667 billion in comparison with the initial budget from the previous year and a decrease of ¥13.26 billion in comparison with the revised supplementary budget from the previous year. Expenditures grew by 1.8% (in comparison with the initial budget from the previous year). Table 2 shows the FY 1988 budget in terms of important items.

**Table 2A. FY 1988 Science and Technology Agency Budget**
**(Unit: ¥1 million; * National Treasury debt liability)**

| | (Previous Year's Initial Budget) | FY 1988 Budget Amount | (Comparative Increase or Decrease) | (Percentage of Previous Year's Budget) |
|---|---|---|---|---|
| | * 139,353 | * 140,925 | * 1,572 | |
| (1) General accounts | 333,674 | 340,410 | 6,736 | 102.0% |
| (2) Special accounts for industrial investment | 4,300 | 4,700 | 400 | 109.3% |
| (3) Special accounts for promoting development of electric power resources | * 82,060 | * 79,410 | * -2,650 | |
| | 94,552 | 95,083 | 531 | 100.6% |
| A. Electric power resource siting account | 12,596 | 15,032 | 2,436 | 119.3% |
| B. Electric power resource diversification account | * 82,060 | * 79,410 | * -2,650 | |
| | 81,956 | 80,051 | -1,905 | 97.7% |
| Total | * 221,413 | * 220,335 | * -1,078 | |
| | 432,526 | 440,193 | 7,667 | 101.8% |

**Table 2B. Main Content of FY 1988 Science and Technology Agency Budget**
**(Unit: ¥ 1 million; * National Treasury debt liability)**

| Item | Previous Year's Budget Amount | FY 1988 Budget Amount | Comparative Increase or Decrease | Remarks | |
|---|---|---|---|---|---|
| | A | B | B-A | | |
| 1. Comprehensive development of S&T administration | 8,483 | 9,530 | 1,047 | 112.3% | |
| (1) Establishing the National Institute for Science and Technology Policy | 0 | 252 | 252 | Established on 1 July 1988, replaces the National Resources Institute | |
| (2) Expanding the Coordination Funds for Promoting Science and Technology | 8,400 | 9,200 | 800 | Internationally fluid basic research promotion, etc. | |
| 2. Expanding and strengthening creative, fundamental research | * 491 | | * -491 | | |
| | 4,843 | 5,631 | 788 | 116.3% (includes doubly-accounted-for portions of other items) | |
| (1) Promoting the Human Frontier Science Program | [150] | [300] | [150] | Estimated amounts of appropriations from the Coordination Funds for Promoting S&T | |
| (2) Expanding the International Frontier Research System | * 491 | | * -491 | Rounding-out research in 2 fields: Biohomeostasis and Frontier Materials | |
| | 1,535 | 1,515 | -20 | Starting research in one new field (Thought Functions) | |
| (3) Expanding the Creative S&T Promotion System | 3,158 | 3,816 | 658 | 3 new subjects: (Quantum Functional Structures, Pico-Second Science, Botanical Information Substances [all temporary names]) | |
| 3. Promoting international S&T cooperation | [* 43,736] | [* 42,431] | [* -1,305] | | |
| | [29,719] | [32,366] | [2,647] | 108.9% (includes doubly-accounted-for portions of other items) | |
| General accounts | * 43,736 | * 42,431 | * -1,305 | Cooperation with developed countries | * 41,853 |
| | 29,383 | 31,880 | 2,497 | | 26,370 |
| Special accounts for industrial investments | 336 | 486 | 150 | Cooperation with developing countries | 2,183 |
| Strengthening international researcher exchange | 1,807 | 1,918 | 111 | (includes doubly-accounted-for portions of other items) | |
| | | | | Exchange with developed countries | 1,285 |
| | | | | Exchange with developing countries | 350 |
| 4. Maintaining the R&D base | 9,439 | 10,288 | 849 | 109.0% | |
| (1) Promoting earth S&T | 8 | 162 | 154 | (includes doubly-accounted-for portions of other items) Promoting the advancement of regional R&D, etc. | |
| (2) Promoting large radiation (SOR—Synchrotron Orbit Radiation) facility projects | [69] | [612] | [543] | (includes doubly-accounted-for portions of other items) Large radiation (SOR) facilities R&D, etc. | |

**Table 2B. Main Content of FY 1988 Science and Technology Agency Budget (Unit: ¥ 1 million; * National Treasury debt liability) (Continued)**

| Item | Previous Year's Budget Amount | FY 1988 Budget Amount | Comparative Increase or Decrease | Remarks | |
|---|---|---|---|---|---|
| | A | B | B-A | | |
| (3) Promoting governmental, academic, and industrial research exchange, etc. | 2,499 | 2,512 | 13 | Special joint governmental-private research | 151 |
| | | | | Domestic and overseas training for government researchers, etc. | 473 |
| | | | | High-Tech Consortium System | 209 |
| | | | | Research Development Corp. of Japan | 1,536 |
| | | | | Total Research Development Corp. of Japan amount including Creative S&T and High-Tech Consortium funds | 5,561 |
| | | | | Limit of commissioned development contracts | 5200 |
| (4) Promoting the circulation of S&T information | 6,373 | 6,769 | 396 | JICST | 6,761 |
| General accounts | 2,073 | 2,069 | -4 | Database expansion | 4,380 |
| Special accounts for industrial investments | 4,300 | 4,700 | 400 | Expanding on-line services | 3,077 |
| | | | | Development of the new on-line access system (JOIS-III) | 468 |
| | | | | Management of the international S&T information network (STN) | 737 |
| | | | | Building a machine translation system | 359 |
| (5) Maintaining Systems for Gathering, Storing and Supplying Genetic Resources | 490 | 333 | -157 | Cell and gene preservation enterprises | 215 |
| | | | | Microbiological strains preservation and supply enterprises | 101 |
| 5. Promoting R&D in essential leading-edge S&T fields | * 221,363 | * 220,334 | * -1,029 | | |
| | 412,553 | 417,467 | 4,914 | 101.2% | |
| (1) Promoting nuclear energy R&D, utilization, and safety measures | * 118,359 | * 113,304 | * -5,055 | | |
| | 273,363 | 271,490 | -1,873 | 99.3% | |
| (General accounts) | * 36,299 | * 33,894 | * -2,405 | | |

**Table 2B. Main Content of FY 1988 Science and Technology Agency Budget (Unit: ¥ 1 million; * National Treasury debt liability) (Continued)**

| Item | Previous Year's Budget Amount | FY 1988 Budget Amount | Comparative Increase or Decrease | Remarks | |
|---|---|---|---|---|---|
| | A | B | B-A | | |
| | 178,811 | 176,407 | -2,404 | 98.7% | |
| A. Expanding and strengthening nuclear power safety measures and means for coping with nuclear nonproliferation | 1,982 | 1,944 | -38 | Enforcing the Nuclear Reactor Regulatory Act | 88 |
| | | | | Safeguards and nuclear fuel protection measures | 602 |
| B. JAERI | * 23,129 | *22,309 | * -820 | Safety research | * 8,002 |
| | 99,462 | 97,310 | -2,152 | | 11,217 |
| | | | | Fusion R&D | *3,960<br>23,356 |
| | | | | JT-60 construction and operations | *3,200<br>17,151 |
| | | | | Participation in the International Thermal Fusion Experimental Reactor (ITER) | *760<br>1,747 |
| | | | | Nuclear ship R&D | 7,313 |
| | | | | High-temperature test reactor implementation, design, etc. | 950 |
| | | | | High-tech radioactivity research | *5,803<br>2,313 |
| | | | | Large radiation (SOR) facilities R&D, etc. | 178 |
| C. Power Reactor and Nuclear Fuel Development Corp. | * 5,740 | * 5,431 | * -309 | Total PNC amount including funds from special accounts for promoting the development of electric power resources | * 84,841<br>138,085 |
| | | | | Power reactor development | *4,427<br>32,910 |
| | | | | FBR development | *2,362<br>16,548 |
| | | | | Reprocessing technology development | 7,735 |
| | | | | High-level-waste processing technology development | 3,612 |
| | | | | Overseas exploration for uranium resources | 2,848 |
| | | | | Uranium-enrichment technology development | *1,004<br>2,622 |
| D. National Institute of Radiological Sciences | * 3,100 | * 5,704 | * 2,604 | Heavy-particle-beam cancer treatment device production | * 5,704<br>2,656 |

**Table 2B. Main Content of FY 1988 Science and Technology Agency Budget (Unit: ¥ 1 million; * National Treasury debt liability) (Continued)**

| Item | Previous Year's Budget Amount | FY 1988 Budget Amount | Comparative Increase or Decrease | Remarks | |
|---|---|---|---|---|---|
| | A | B | B-A | | |
| E. RIKEN nuclear power research | * 4,330 | * 450 | * -3,880 | Heavy-ion accelerator construction and operations | * 450<br>3,452 |
| | | | | Laser-based uranium-enrichment technology development | 395 |
| | | | | Large radiation (SOR) facilities R&D, etc. | 285 |
| F. Nuclear power test research in national research institutions | 1,789 | 1,815 | 26 | Expenditures for each ministry's and agency's nuclear power research lumped together | |
| (Special accounts for promoting the development of electric power resources) | * 82,060 | * 79,410 | * -2,650 | | |
| | 94,552 | 95,083 | 531 | 100.6% | |
| A. Electric power resource siting | 12,596 | 15,032 | 2,436 | 119.3% | |
| | | | | Consignment fees for nuclear power generation safety measures, etc. | 5,975 |
| | | | | Subsidies for measures to facilitate electric resource siting | 4,088 |
| | | | | Special subsidies for electric power resource siting | 1,424 |
| | | | | Subsidies fornuclear power generation safety measures, etc. | 3,412 |
| B. Electric power resource diversification | * 82,060 | * 79,410 | * -2,650 | | |
| | 81,956 | 80,051 | -1,905 | 97.7% | |
| i) Power Reactor and Nuclear Fuel Development Corp. | * 82,060 | * 79,410 | * -2,650 | "Monju" FBR construction | * 60,908 |
| | 77,264 | 75,806 | -1,458 | | 48,745 |
| ii) Other | 4,692 | 4,245 | -447 | Reprocessing development | *18,502<br>8,430 |
| | | | | Commissioned development of reactor dismantling technology, etc. | 1,796 |
| | | | | Commissioned development of laser-based uranium-enrichment technology | 740 |
| | | | | Aid for development of radioactive-waste processing and disposal technology, etc. | 429 |

**Table 2B. Main Content of FY 1988 Science and Technology Agency Budget (Unit: ¥ 1 million; * National Treasury debt liability) (Continued)**

| Item | Previous Year's Budget Amount | FY 1988 Budget Amount | Comparative Increase or Decrease | Remarks | |
|---|---|---|---|---|---|
| | A | B | B-A | | |
| (1) Promoting space development and utilization | * 94,190 | * 102,604 | * 8,414 | | |
| | 94,569 | 98,470 | 3,901 | 104.1% | |
| A. National Space Development Agency of Japan | * 94,035 | * 102,457 | * 8,422 | H-II rocket development | * 50,189<br>34,333 |
| | | | | No 3-b communications satellite development | 2,215 |
| | | | | No 4 geostationary meteorological satellite development | *100<br>1,544 |
| | | | | No 1-b marine observation satellite development | *1,949<br>613 |
| | | | | Development of the No 3 broadcast satellites | *4,621<br>3,041 |
| | | | | No 1 earth resources satellite development | *3,839<br>3,610 |
| | | | | Type-VI engineering test satellite development | *22,357<br>4,949 |
| | | | | No 5 geostationary meteorological satellite development | *478<br>197 |
| | | | | Earth observation platform engineering satellite R&D | *2,005<br>542 |
| | | | | First materials testing system development | *1,244<br>794 |
| | | | | Participation in the space station program | *8,893<br>6,436 |
| B. National Aerospace Laboratory's space-S&T-related items | * 155 | * 147 | * -8 | Research on liquid oxygen/liquid hydrogen engine elements for use in H-II rockets | * 147<br>217 |
| (3) Promoting marine development | * 7,135 | | * -7,135 | 122.8% | |
| | 7,727 | 9,487 | 1,760 | | |
| A. Marine S&T Center | * 7,135 | | * -7,135 | Deep-sea research studies | 6,465 |
| | | | | Building the 6000-meter-class research submersible | 3,777 |
| | | | | Building the support mother ship for the submersible | 1,270 |
| | | | | Diving technology R&D | 1,181 |
| | | | | Operating undersea experiment vessels | 979 |
| | | | | Regional joint R&D | 50 |

**Table 2B. Main Content of FY 1988 Science and Technology Agency Budget (Unit: ¥ 1 million; * National Treasury debt liability) (Continued)**

| Item | Previous Year's Budget Amount | FY 1988 Budget Amount | Comparative Increase or Decrease | Remarks | |
|---|---|---|---|---|---|
| | A | B | B-A | | |
| B. Other | | | | Black Current development and utilization research studies | 113 |
| (4) Promoting R&D in materials/ substance S&T | * 231 | * 2,442 | * 2,211 | 118.4% | |
| | 9,437 | 11,171 | 1,734 | (includes doubly-accounted-for portions of other items) | |
| New superconductor research related | 0 | *2,442 | *2,442 | National Research Institute for Metals | *1,216 |
| | 0 | 2,044 | 2,044 | | 5,174 |
| All superconductor research | | * 2,442 | * 2,442 | Maintaining a system for evaluating the characteristics of superconductors in a superstrong magnetic field | * 1,216 |
| | 1,583 | 3,192 | 1,609 | | 895 |
| | | | | National Institute for Research in Inorganic Materials | *1,226<br>2,257 |
| | | | | Maintaining the super-high-resolution super-high-pressure electron microscope | *900<br>270 |
| | | | | Estimated amount of appropriations from the Coordination Funds for Promoting S&T | 2,300 |
| | | | | Creative S&T Promotion System (except for Quantum Functional Structures [temporary name]) | 574 |
| | | | | Frontier research (Frontier Materials) | 384 |
| (5) Promoting the life sciences | *4,080 | *6,792 | *2,712 | 107.6% | |
| | 11,908 | 12,809 | 901 | (includes doubly-accounted-for portions of other items) | |
| Human systems S&T R&D | * 440 | | * -440 | Institute for Physical and Chemical Research | * 1,088<br>2,799 |
| Cancer-related research | * 3,639 | * 5,704 | * 2,065 | Frontier research (Biohomeostasis, Thought Functions) | 546 |
| | 5,545 | 6,253 | 708 | Research in neurology, immunology, etc. | 320 |
| | | | | Estimated amount of appropriations from the Coordination Funds for Promoting S&T | 1,900 |

**Table 2B. Main Content of FY 1988 Science and Technology Agency Budget (Unit: ¥ 1 million; * National Treasury debt liability) (Continued)**

| Item | Previous Year's Budget Amount | FY 1988 Budget Amount | Comparative Increase or Decrease | Remarks | |
|---|---|---|---|---|---|
| | A | B | B-A | | |
| | | | | Estimated amount of commissioned development of new technology | 1,543 |
| | | | | Creative S&T Promotion System (except for Botanical Information Substances[temporary name]) | 1,597 |
| | | | | National Institute of Radiological Sciences | *5,704<br>4,417 |
| | | | | Research on medical uses of heavy particle beams | *5,704<br>2,815 |
| (6) Promoting R&D in earth S&T, etc. | * 14,074 | * 8,371 | * -5,703 | 96.8% | |
| | 18,232 | 17,651 | -581 | | |
| A. Promoting earth observation technology R&D, etc. | * 14,049 | * 8,371 | * -5,678 | (includes doubly-accounted-for portions of other items) | |
| | 15,677 | 15,083 | -594 | | |
| | | | | No 4 geostationary meteorological satellite development | *100<br>1,544 |
| | | | | No 1-b marine observation satellite development | *1,949<br>613 |
| | | | | No 1 earth resources satellite development | *3,839<br>3,610 |
| | | | | No 5 geostationary meteorological satellite development | *478<br>197 |
| | | | | Earth observation platform engineering satellite R&D | *2,005<br>542 |
| A. Promoting R&D in disaster prevention S&T | * 25 | | * -25 | National Research Center for Disaster Prevention | 2,563 |
| | 2,555 | 2,568 | 13 | Earthquake prediction research | 924 |
| | | | | Research on countermeasures for earthquake damages | 502 |
| | | | | Research on countermeasures for snow damages | 74 |
| (7) Promoting other important comprehensive research, etc. | * 1,034 | *1,985 | * 951 | 101.2% | |
| | 8,880 | 8,710 | -170 | ;1;2 | |
| A. National Aerospace Laboratory's aircraft-technology-related research | * 494 | * 897 | * 403 | Fan-jet STOL aircraft R&D | 2,340 |

**Table 2B. Main Content of FY 1988 Science and Technology Agency Budget (Unit: ¥1 million; * National Treasury debt liability) (Continued)**

| Item | Previous Year's Budget Amount | FY 1988 Budget Amount | Comparative Increase or Decrease | Remarks | |
|---|---|---|---|---|---|
| | A | B | B-A | | |
| | 18,988 | 19,719 | 231 | Innovative aerospace transport elemental technology research (total including the space amount) | *653<br>664 |
| | | | | Total amount for the National Aerospace Laboratory including space systems research | *1,044<br>10,110 |
| B. Other | * 540 | * 1,088 | * 548 | RIKEN | * 1,088<br>10,236 |
| | | | | Laser S&T research | 214 |
| | | | | Large radiation (SOR) facilities R&D, etc. | 145 |
| | | | | RIKEN's total amount including nuclear power research and frontier research | *1,538<br>16,034 |
| | | | | Promoting public relations and education activities | 122 |

(From the Finance Division of the Director-General's Secretariat)

## Personnel

**Table 4. Staff Changes**

| Organizational Category | Number of Personnel at the end of FY 1988 | Organizational Category | Number of Personnel at the end of FY 1989 |
|---|---|---|---|
| Internal Departments | 512 | Internal Departments | 515 |
| Director-General's Secretariat | 105 | Director-General's Secretariat | 109 |
| S&T Policy Bureau | 50 | S&T Policy Bureau | 50 |
| S&T Promotion Bureau | 61 | S&T Promotion Bureau | 57 |
| R&D Bureau | 69 | R&D Bureau | 70 |
| Atomic Energy Bureau | 91 | Atomic Energy Bureau | 92 |
| Nuclear Safety Bureau | 136 | Nuclear Safety Bureau | 137 |
| Regional Branch Division Departments | 10 | Regional Branch Division Departments | 10 |
| Mito Nuclear Power Office | 10 | Mito Nuclear Power Office | 10 |
| Affiliated Organizations | 1,610 | Affiliated Organizations | 1,603 |
| National Aerospace Laboratory | 448 | National Aerospace Laboratory | 446 |
| National Research Institute for Metals | 437 | National Research Institute for Metals | 434 |
| National Institute of Radiological Sciences | 397 | National Institute of Radiological Sciences | 394 |
| National Research Center for Disaster Prevention | 117 | National Research Center for Disaster Prevention | 118 |
| National Institute for Research in Inorganic Materials | 165 | National Institute for Research in Inorganic Materials | 165 |
| National Institute for Science and Technology Policy | 46 | National Institute for Science and Technology Policy | 46 |
| Total | 2,132 | Total | 2,128 |

**Table 5. Fixed Staff Numbers by Class**

| Position Name | Class | STA | NAL | NRIM | NIRS | NRCDP | NIRIM | NISTP | Total |
|---|---|---|---|---|---|---|---|---|---|
| Appointed Positions | | | | | | | | | |
| Permanent Vice-Minister | | 1 | - | - | - | - | - | - | 1 |
| Deputy Vice-Minister for Scientific Counselor | | 1 | - | - | - | - | - | - | 1 |
| Directors of the Secretariat/Bureau Directors | | 6 | - | - | - | - | - | - | 6 |
| Deputy Bureau Director | | 1 | - | - | - | - | - | - | 1 |
| Councilors | | 4 | - | - | - | - | - | - | 4 |
| Scientific Research Officials | | - | 1 | 1 | 1 | - | - | - | 3 |
| Total | | 13 | 2 | 2 | 2 | 1 | 1 | 1 | 22 |
| Administrative Positions (1) | | | | | | | | | |
| Councilors | 11 | 1 | - | - | - | - | - | - | 1 |
| Department Managers | 11 | - | 1 | 1 | 1 | - | - | - | 3 |
| | 10 | - | - | - | 1 | 1 | 1 | - | 3 |
| General Affairs Research Officials | 11 | - | - | - | - | - | - | 1 | 1 |
| Section Managers | 11 | 17 | - | - | - | - | - | - | 17 |
| | 10 | 12 | - | - | - | - | - | - | 12 |
| | 9 | - | 2 | 2 | 2 | 1 | 1 | 1 | 9 |
| | 8 | - | 4 | 3 | 6 | 3 | 2 | 2 | 20 |
| | 7 | - | 1 | 1 | 1 | 1 | 1 | - | 5 |
| Supervisory Officials | 11 | 1 | - | - | - | - | - | - | 1 |
| Office Chiefs | 10 | 10 | - | - | - | - | - | - | 10 |
| | 9 | 1 | - | - | - | - | - | - | 1 |
| Administrative Officials | 10 | 1 | - | - | - | - | - | - | 1 |
| | 9 | 10 | - | - | - | - | - | - | 10 |
| Coordination Officials | 10 | 1 | - | - | - | - | - | - | 1 |
| | 9 | 6 | - | - | - | - | - | - | 6 |
| Planning Officials | 9 | 5 | - | - | - | - | - | - | 5 |
| Investigations Officials | 9 | 1 | - | - | - | - | - | - | 1 |
| Office Directors | 9 | 1 | - | - | - | - | - | - | 1 |
| Assistants to Section Managers | 9 | 5 | - | - | - | - | - | - | 5 |
| | 8 | 38 | 1 | - | - | - | - | - | 39 |
| | 7 | 40 | 3 | 2 | 3 | 1 | 1 | 1 | 51 |
| | 6 | - | 4 | 3 | 5 | - | - | - | 12 |
| Expert Positions | 10 | 2 | - | - | - | - | - | - | 2 |
| | 9 | 1 | - | - | - | - | - | *3 | 4 |
| | 8 | 16 | - | - | - | - | - | *7 | 23 |
| | 7 | 24 | 2 | 1 | 3 | - | - | *4 | 34 |
| | 6 | 56 | 8 | 2 | 6 | 6 | *2 | 2 | 82 |
| | 4 | 16 | - | - | - | - | - | - | 16 |
| Chief Clerks | 5 | 31 | 12 | 11 | 17 | 4 | 4 | - | 79 |
| | 5 | 42 | 6 | 5 | 7 | 2 | 2 | 1 | 65 |
| | 4 | 37 | 8 | 6 | 10 | 6 | 5 | 4 | 76 |

**Table 5. Fixed Staff Numbers by Class (Continued)**

| Position Name | Class | STA | NAL | NRIM | NIRS | NRCDP | NIRIM | NISTP | Total |
|---|---|---|---|---|---|---|---|---|---|
| | 3 | 37 | 3 | 2 | 5 | - | 3 | - | 50 |
| Managers | 5 | 1 | 1 | - | 1 | - | - | - | 3 |
| | 4 | 5 | 4 | 2 | 3 | 1 | - | 1 | 16 |
| | 3 | 1 | - | 1 | 1 | - | - | - | 3 |
| Technical Positions | 5 | - | - | 2 | - | - | 1 | - | 3 |
| | 4 | - | - | 4 | - | - | 4 | - | 8 |
| | 3 | - | - | 2 | - | - | 7 | - | 9 |
| General Positions | 3 | 30 | 12 | 12 | 19 | 5 | 8 | 4 | 90 |
| | 2 | 15 | 11 | 9 | 16 | 2 | - | 4 | 57 |
| | 1 | 8 | 8 | 7 | 10 | 1 | - | - | 34 |
| Total | | 488 | 91 | 78 | 117 | 34 | 42 | 35 | 885 |
| Administrative Positions (2) | | | | | | | | | |
| Technicians (1st class) | 4 | 1 | 1 | - | - | - | - | - | 2 |
| | 3 | - | 2 | 1 | 1 | - | - | - | 4 |
| | 2 | - | - | - | - | - | - | - | - |
| Technicians (2nd class) | 6 | 1 | 1 | 1 | - | - | - | - | 3 |
| | 5 | 4 | 4 | 6 | 4 | - | - | - | 18 |
| | 4 | 12 | 5 | 4 | 5 | 1 | - | 1 | 28 |
| | 3 | 3 | - | 9 | 7 | 5 | 2 | - | 26 |
| | 2 | - | - | - | 3 | - | - | - | 3 |
| Laborers (1st class) | 5 | 1 | 1 | 1 | - | - | - | - | 3 |
| | 4 | 1 | 1 | - | - | - | - | - | 2 |
| | 3 | 1 | 1 | - | - | - | 1 | - | 3 |
| | 2 | - | - | - | - | - | - | - | - |
| Total | | 24 | 16 | 22 | 20 | 6 | 3 | 1 | 92 |
| Specialized Administrative Positions | | | | | | | | | |
| Department Managers | 4 | - | 1 | - | - | - | - | - | 1 |
| Chief Clerks | 3 | - | 1 | - | - | - | - | - | 1 |
| Expert Positions | 3 | - | 1 | - | - | - | - | - | 1 |
| | 2 | - | 1 | - | - | - | - | - | 1 |
| Total | | - | 4 | - | - | - | - | - | 4 |
| Research Positions | | | | | | | | | |
| Researchers that are department managers, office directors, etc. | 5 | - | 87 | 93 | 72 | 23 | 38 | 2 | 315 |
| | 4 | - | 72 | 64 | 43 | 17 | 39 | 2 | 237 |
| | 3 | - | 63 | 55 | 41 | 12 | 24 | 2 | 197 |
| Researchers | 2 | - | 106 | 89 | 37 | 25 | 18 | 3 | 278 |
| Research Assistants | 1 | - | 5 | 31 | 14 | - | - | - | 50 |
| Total | | - | 333 | 332 | 207 | 77 | 119 | 9 | 1,077 |
| Medical Positions (1) | | | | | | | | | |
| Department Managers | 4 | - | - | - | 1 | - | - | - | 1 |
| Section Managers | 3 | - | - | - | 2 | - | - | - | 2 |
| Physicians | 2 | - | - | - | 5 | - | - | - | 5 |
| | 1 | - | - | - | 2 | - | - | - | 2 |
| Total | | - | - | - | 10 | - | - | - | 10 |
| Medical Positions (2) | | | | | | | | | |

**Table 5. Fixed Staff Numbers by Class (Continued)**

| Position Name | Class | STA | NAL | NRIM | NIRS | NRCDP | NIRIM | NISTP | Total |
|---|---|---|---|---|---|---|---|---|---|
| Pharmacists | 6 | - | - | - | 1 | - | - | - | 1 |
| | 5 | - | - | - | - | - | - | - | - |
| | 4 | - | - | - | - | - | - | - | - |
| | 3 | - | - | - | 1 | - | - | - | 1 |
| Nutritionists | 3 | - | - | - | 1 | - | - | - | 1 |
| Radiologists and X-Ray Technologists | 5 | - | - | - | 1 | - | - | - | 1 |
| | 4 | - | - | - | 1 | - | - | - | 1 |
| | 3 | - | - | - | 1 | - | - | - | 1 |
| | 2 | - | - | - | 1 | - | - | - | 1 |
| Clinical Trial Technologists | 5 | - | - | - | 1 | - | - | - | 1 |
| | 4 | - | - | - | 1 | - | - | - | 1 |
| | 3 | - | - | - | - | - | - | - | - |
| | 2 | - | - | - | 1 | - | - | - | 1 |
| Total | | - | - | - | 10 | - | - | - | 10 |
| Medical Positions (3) | | | | | | | | | |
| Nursing Directors | 5 | - | - | - | 1 | - | - | - | 1 |
| Nursing Chiefs | 4 | - | - | - | 2 | - | - | - | 2 |
| | 3 | - | - | - | 4 | - | - | - | 4 |
| Nurses | 2 | - | - | - | 20 | - | - | - | 20 |
| | 1 | - | - | - | 1 | - | - | - | 1 |
| Total | | - | - | - | 28 | - | - | - | 28 |

Note: STA = Science and Technology Agency;
NAL = National Aerospace Laboratory;
NRIM = National Research Institute for Metals;
NIRS = National Institute of Radiological Sciences;
NRCDP = National Research Center for Disaster Prevention;
NIRIM = National Institute for Research in Inorganic Materials;
NISTP = National Institute for Science and Technology Policy.
* Expert officials
(From the Personnel Division of the Director-General's Secretariat)

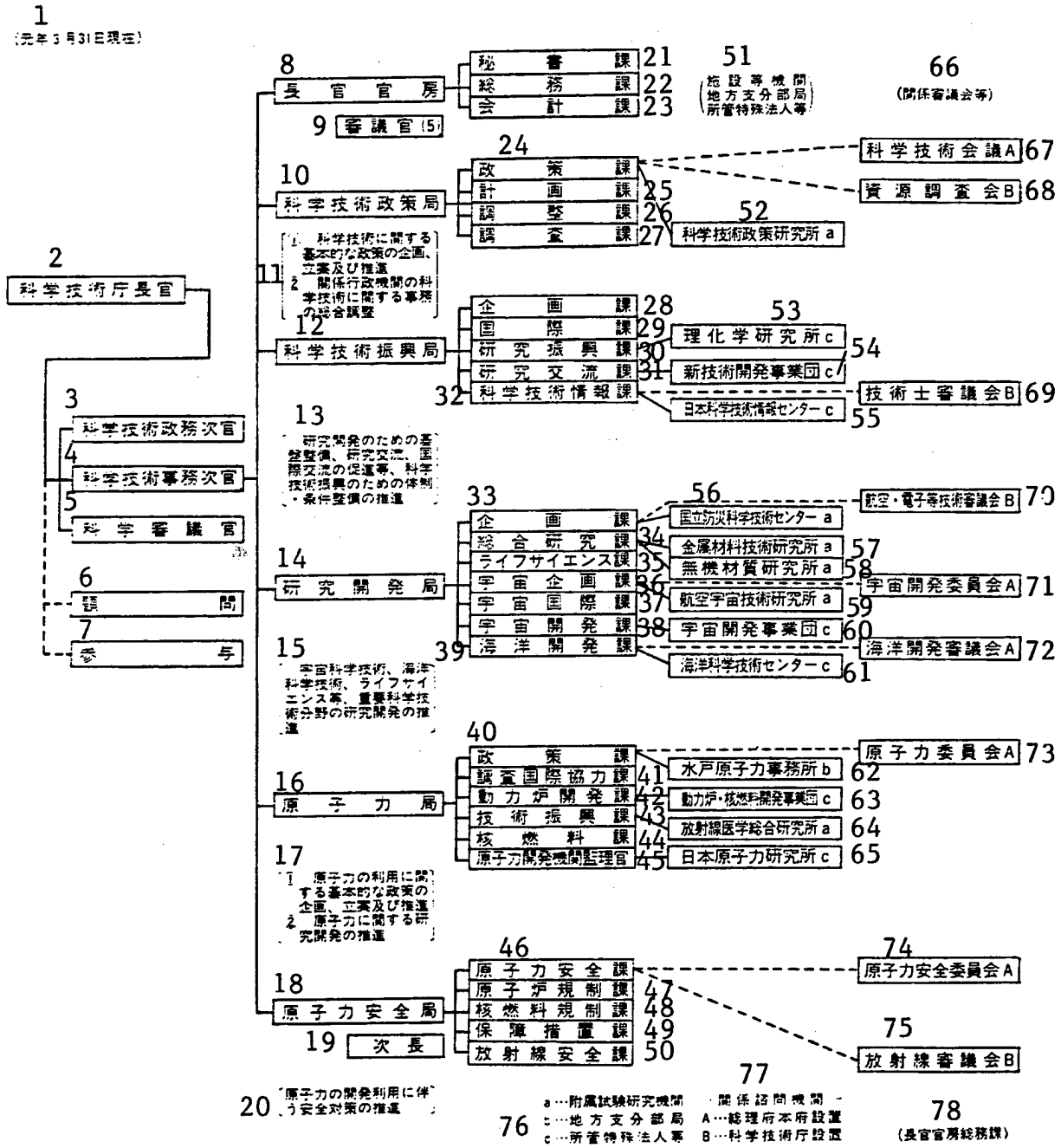
## Administrative Organization Maintenance

Internal Departments

| | |
|---|---|
| **Organizations** | |
| (Research and Development Promotion Division of the Science and Technology Promotion Bureau) | R&D base coordination officials |
| (Space Activities Planning Division of the Research and Development Bureau) | Space transport research coordination officials |
| (Safeguards Division of the Nuclear Safety Bureau) | Nuclear substance protection and control officials |
| **Personnel** | |
| (Planning Division of the Science and Technology Policy Bureau) | Experts |
| (Research and Development Cooperation Division of the Science and Technology Promotion Bureau) | Regional research exchange officials |
| (Interministerial Research and Development Division of hte Research and Development Bureau) | Chief clerks |
| (Space Development Division of the Research and Development Bureau) | Chief clerks |
| (Policy Division of the Atomic Energy Bureau) | Four nuclear energy liaison and coordination officials |
| (Reactor Regulation Division of the Nuclear Safety Bureau) | Operations management expert officials |
| (Nuclear Materials Regulation Division of the Nuclear Safety Bureau) | Safety inspection officials |

| Administrative Organization Maintenance (Continued) | |
|---|---|
| (Reactor Regulation Division of the Nuclear Safety Bureau) | Safety inspection officials |
| (Safeguards Division of the Nuclear Safety Bureau) | Nuclear substance protection officials |
| Facilities and other organizations | |
| **Organizations** | |
| (National Aerospace Laboratory) | Internal reorganization (5 departments and 1 research group became 6 departments) |
| (National Research Institute for Metals) | Internal reorganization (13 departments and 2 groups became 10 departments and 5 groups) |
| (National Institute of Radiological Sciences) | Pharmaco-Chemical Research Department |
| (National Research Center for Disaster Prevention) | Internal reorganization (Redistribution of 4 research groups' work) |
| (National Research Center for Disaster Prevention) | Branch offices' names changed |
| (National Institute for Science and Technology Policy) | General research affairs official |
| (National Institute for Science and Technology Policy) | Information systems section chief |
| (National Institute for Science and Technology Policy) | Research Group two newly established |
| (National Institute for Science and Technology Policy) | Investigations Group four newly established |
| **Personnel** | |
| (National Aerospace Laboratory) | Flight experiment control officials (Retainment period extended one year) |
| (National Aerospace Laboratory) | Engine department researchers |
| (National Aerospace Laboratory) | Control and power department experts |
| (National Research Institute for Metals) | Researchers in the 1st research group |
| (National Research Institute for Metals) | Experts in the Tsukuba branch office's management section |
| (National Institute of Radiological Sciences) | Managers and research officials in the medical-use heavy-particle-beam research department |
| (National Institute for Research in Inorganic Materials) | Managers and research officials in the 14th research group |
| (From the General Affairs Division of the Director-General's Secretariat) | |

## Science and Technology Agency Organizational Chart



Key:—1. (31 March 1989)—2. Director-General of the Science and Technology Agency—3. Parliamentary Vice-Minister for Science and Technology—4. Administrative Vice-Minister for Science and Technology—5. Deputy Vice-Minister for Scientific Coucilor—6. Councilors—7. Advisers—8. Director-General's Secretariat—9. Councilors (5)—10. Science and Technology Policy Bureau—11. 1) Planning, drafting, and promoting basic S&T-related policies; 2) Overall coordination of S&T-related affairs of concerned administrative organizations.—12. Science and Technology Promotion Bureau—13. Maintaining the R&D base, research exchange, promoting international exchange, etc.; promoting the maintenance of systems and conditions for S&T promotion—14. Research and Development Bureau—15. Promoting R&D in important S&T fields, such as space S&T, marine S&T, the life sciences, etc.—16. Atomic Energy Bureau—17. 1) Planning, drafting, and promoting basic atomic-energy-related policies; 2) Promoting atomic-energy-related R&D.—18. Nuclear Safety Bureau—19. Assistant Director—20. Promoting safety measures attendant upon the development and utilization of nuclear energy—21. Personnel Division—22. General Affairs Division—23. Accounting Division—24. Policy Division—25. Planning Division—26. Coordination Division—27. Research Division—28. Policy Division—29. International Cooperation Division—30. Research and Development Promotion Division—31. Research and Development Cooperation Division—32. Science and Technology Information Division—33. Policy Division—34. Interministerial Research and Development Division—35. Life Sciences Division—36. Space Activities Planning Division—37. International Space Affairs Division—38. Space Development Division—39. Ocean Development Division—40. Policy Division—41. Research and International Affairs Division—42. Power Reactor Development Division—43. Technology Development Division—44. Nuclear Fuel Division—45. Administrator of Atomic Energy Institutes—46. Nuclear Safety Division—47. Reactor Regulation Division—48. Nuclear Materials Regulation Division—49. Safeguards Division—50. Radiation Protection Division—51. (Facilities and other organizations, regional bureau branches, semigovernmental organizations, etc.)—52. National Institute for Science and Technology Policy (a)—53. Institute for Physical and Chemical Research (c)—54. Research Development Corp. of Japan (c)—55. Japan Information Center for Science and Technology (c)—56. National Research Center for Disaster Prevention (a)—57. National Research Institute for Metals (a)—58. National Institute for Research in Inorganic Materials (a)—59. National Aerospace Laboratory (a)—60. National Space Development Agency of Japan (c)—61. Japan Marine Science and Technology Center (c)—62. Mito Nuclear Power Office (b)—63. Power Reactor and Nuclear Fuel Development Corp. (c)—64. National Institute of Radiological Sciences (a)—65. Japan Atomic Energy Research Institute (c)—66. (Related Councils)—67. Council for Science and Technology (A)—68. Resources Research Council (B)—69. Technical Fellows Council (B)—70. Council for Aeronautics, Electronics and Other Advanced Technologies (B)—71. Space Development Commission (A)—72. Marine Development Council (A)—73. Atomic Energy Commission (A)—74. Nuclear Safety Commission (A)—75. Radiation Council (B)—76. (a) Affiliated test research institutes; (b) Regional bureau branches; (c) Semigovernmental organizations—77. Related advisory organs: (A) Established within the Prime Minister's Office; (B) Established within the Science and Technology Agency—78. (From the General Affairs Division of the Director-General's Secretariat)

## Main Personnel

These personnel changes were from 1 April 1988 to 31 March 1989. "A" indicates that the named individual assumed the office mentioned; "M" that the individual was moved or relocated to the post; "P" that the individual was promoted to the post; "T" that the individual was transferred; "L" that the individual was loaned or temporarily transferred from another department; "R" that the individual retired; "D" that the individual died; "S" that the individual is handling the post because of special circumstances; and "C" that the post is combined with another.

### 1. Director-General and Staff

| | | | |
|---|---|---|---|
| **Director-General** | Soichiro Ito | 27 December 1988 | R |
| | Shigeichi Miyazaki | 27 December 1988 | A |
| **Parliamentary Vice-Minister** | Hiroshi Takeyama | 28 December 1988 | R |
| | Yoshio Yoshikawa | 28 December 1988 | A |
| **Administrative Vice-Minister** | Toshio Uchida | | |
| **Deputy Vice-Minister for Scientific Coucilor** | Moriyuki Nakamura | | |

### Director-General's Secretariat

| | | | |
|---|---|---|---|
| Director of the Secretariat | Akinori Migaku | | |
| Councilor | Hironari Hirano | 1 July 1988 | P (Atomic Energy Bureau Director) |
| | Tadayoshi Suda | 1 July 1988 | A |
| | Hiroyuki Shima | 1 July 1988 | T |
| | Sadayasu Hirose | 1 July 1988 | A |

| Director-General's Secretariat | | | |
|---|---|---|---|
| | Settsuo Matsuzawa | | |
| | Hideo Nakazawakawa | | |
| | Masahisa Ida | | |
| Personnel Division Manager | Fujio Sakauchi | 27 June 1988 | T |
| | Hirofumi Satake | 27 June 1988 | A |
| General Affairs Division Manager | Hidenori Nagata | 10 June 1988 | T |
| | Toshihiro Ishii | 10 June 1988 | A |
| Accounting Division Manager | Akira Takeda | 10 June 1988 | T |
| | Hiroto Sekida | 10 June 1988 | A |

| Science and Technology Policy Bureau | | | |
|---|---|---|---|
| Bureau Director | Akimutsu Kato | 25 June 1988 | R |
| | Moriyuki Nakamura | 25 June 1988 | S |
| | Mitsugi Ishizuka | 1 July 1988 | A |
| Policy Division Manager | Toshihiro Ishii | 10 June 1988 | M (General Affairs Division Manager) |
| | Mitsuhiro Nakamura | 10 June 1988 | A |
| Planning Division Manager | Masao Yamada | 1 July 1988 | M (Personnel and Planning Research Official) |
| | Sadayasu Hirose | 1 July 1988 | S |
| | Masayasu Miyabayashi | 8 August 1988 | A |
| Coordination Division | Tsutomu Imamura | 31 March 1989 | L (Kanagawa Prefecture) |
| Research Division Manager | Yoshiro Miki | | |

| Science and Technology Promotion Bureau | | | |
|---|---|---|---|
| Bureau Director | Haruaki Yoshimura | 1 July 1988 | M (Research and Development Bureau Director) |
| | Kenjiro Ogata | 1 July 1988 | A |
| Policy Division Manager | Katsuyoshi Kuroda | | |
| International Cooperation Division Manager | Masayasu Miyabayashi | 8 August 1988 | M (Planning Division of the Science and Technology Policy Bureau) |
| | Kaname Ikeda | 8 August 1988 | A |
| Research and Development Promotion Division Manager | Yoshio Hironaka | 1 July 1988 | T |
| | Kaoru Mamiya | 1 July 1988 | A |
| Research and Development Cooperation Division Manager | Takeyori Okuma | 31 January 1989 | L (Information Center) |
| | Akio Hayashi | 1 February 1989 | A |
| Science and Technology Information Division Manager | Masao Sato | 1 April 1988 | M (Office of the Director-General's Secretariat) |
| | Haruo Suzuki | 1 April 1988 | A |

## Research and Development Bureau

| | | | |
|---|---|---|---|
| Bureau Director | Masahiro Kawasaki | 1 July 1988 | M (Director of the National Institute for Science and Technology Policy) |
| | Haruaki Yoshimura | 1 July 1988 | A |
| Policy Division Manager | | | |
| Interministerial Research and Development Division | Yasuji Takaoi | | |
| Life Sciences Division Manager | Hiroichi Soga | | |
| Space Activities Planning Division Manager | Shigeru Aoe | | |
| International Space Affairs Division | Masaharu Tanaka | | |
| Space Development Division | Tamotsu Mukai | 14 June 1988 | T |
| | Kenichi Saito | 14 June 1988 | A |
| Ocean Development Division Manager | Makoto Chijitani | 15 July 1988 | L (Power Reactor and Nuclear Fuel Development Corp.) |
| | Nobutsugu Shoji | 16 July 1988 | A |

## Atomic Energy Bureau

| | | | |
|---|---|---|---|
| Bureau Director | Takashi Matsui | 1 July 1988 | R |
| | Hironari Hirano | 1 July 1988 | A |
| Policy Division | Hiroto Sekida | 10 June 1988 | M (Accounting Division Manager) |
| | Yoshimura Atarashii | 10 June 1988 | A |
| Research and International Affairs Division Manager | Kaoru Mamiya | 1 July 1988 | M (Science and Technology Promotion Bureau, Research and Development Promotion Division Manager) |
| | Naotaka Sakan | 1 July 1988 | A |
| Power Reactor Development Division Manager | Toshio Okazaki | | |
| Technology Development Division Manager | Junichi Yamaji | 31 June 1988 | L (JAERI) |
| | Toshiohiro Fukuhara | 1 July 1988 | A |
| Nuclear Fuel Division | Fumio Yuki | | |
| Administrator of Atomic Energy Institutes | Naotaka Sakan | 1 July 1988 | M (Atomic Energy Bureau, Research and International Affairs Division Manager) |
| | Tetsunaga Shirakawa | 1 July 1988 | A |

## Nuclear Safety Bureau

| | | | |
|---|---|---|---|
| Bureau Director | Mitsugi Ishizuka | 1 July 1988 | M (Science and Technology Policy Bureau Director) |
| | Kenichi Murakami | 1 July 1988 | A |
| Assistant Director | Kenjiro Ogata | 1 July 1988 | P (Science and Technology Promotion Bureau Director) |
| | Hiroshi Tani | 1 July 1988 | A |
| Nuclear Safety Division Manager | Kaoru Naito | 27 June 1988 | M (Personnel Division Manager) |
| | Kenjiro Ogata | 27 June 1988 | S |

| Nuclear Safety Bureau (Continued) | | | |
|---|---|---|---|
| | Hiroshi Tani | 27 June 1988 | A |
| Reactor Regulation Division Manager | Kaoru Naito | 15 July 1988 | M (Director-General's Secretariat office) |
| | Mikio Hattori | 15 July 1988 | A |
| Nuclear Materials Regulation Division Manager | Saichiro Yoshimura | 30 June 1988 | L (NASDA) |
| | Katsuyoshi Omori | 1 July 1988 | A |
| Safeguards Division Manager | Hiroshi Tani | 1 July 1988 | M (Nuclear Safety Bureau, Nuclear Safety Division Manager) |
| | Zenichiro Takagi | 1 July 1988 | A |
| Radiation Protection Division Manager | Yoshio Suehiro | | |

| National Aerospace Laboratory | | | |
|---|---|---|---|
| Director | Hideo Nagasu | | |
| Scientific Research Official | Kazuyuki Takeuchi | | |
| Administrative Section Manager | Masaharu Wakasa | 31 May 1988 | L (Marine Center) |
| | Kazuyoshi Tsunawaki | 1 June 1988 | A |
| Aerodynamics Division Manager | Hiroshi Endo | | |
| Structural Dynamics Division Manager | Shinichi Ono | | |
| Heat Flow Body Dynamics Division Manager | Kitao Takahara | 16 October 1988 | T |
| | Akihiro Minota | 16 October 1988 | A |
| Mathematical Analysis Division Manager | Takashi Miyoshi | | |
| Aerodynamic Performance Division Manager | Kazutoshi Takajima | | |
| Airframe Division Manager | Yasuo Tada | | |
| Engine Division Manager | Hirokara Yose | | |
| Control Division Manager | Hajime Kosuke | | |
| Flight Experiments Division Manager | Masayoshi Okabe | | |
| Advanced Aircraft Research Group General Research Official | Nobuyoshi Kamiya | | |
| Space Research Group Manager | Tatsuo Yamanaka | | |
| Kakuda Branch Office Director | Akio Suzuki | | |

On 8 April 1988 there was a partial rearrangement of the research organization based on the organizational changes decided upon in FY 1988.

| National Research Institute for Metals | | | |
|---|---|---|---|
| Director | Ryuichi Naganaka | | |
| Scientific Research Official | Kazuyoshi Arai | | |
| Administrative Department Manager | Atsushi Shaku | 1 May 1988 | R |
| | Karanobu Okui | 1 May 1988 | A |
| Basic Physical Properties Research Department Manager | Akeyasu Yoshikawa | | |
| Functional Characteristics Research Department Manager | Yasuo Sasaki | | |
| Materials Design Research Department Manager | Michio Yamazaki | | |
| Reaction Control Research Department Manager | Fumiro Yoshimatsu | | |

| National Research Institute for Metals (Continued) | | |
|---|---|---|
| Composition Control Research Department Manager | Jigo Nakamura | |
| Measurement and Analysis Research Department Manager | Eiichi Kobayashi | |
| Failure Mechanism Research Department Manager | Satoshi Nishijima | |
| Environmental Performance Research Department Manager | Senshu Tanaka | |
| Third Research Group General Research Official | Narikura Tsujimoto | |
| Fourth Research Group General Research Official | Atsushi Oguchi | |
| Fifth Research Group General Research Official | Tomoyuki Takeuchi | |
| Tsukuba Branch Laboratory Director | Masatoshi Okada | |
| Dynamic Characteristics Research Department Manager | Yoshikuni Kawabe | |
| Surface Interface Control Research Department Manager | Keiichi Kogawa | |
| First Research Group General Research Official | Hiroshi Maeda | |
| Second Research Group General Research Official | Harashige Shiraishi | |

On 8 April 1988 there was an overall rearrangement of the research organization based on the changes decided upon in FY 1988.

| National Institute of Radiological Sciences | | | |
|---|---|---|---|
| Director | Toyozo Terajima | 10 May 1988 | R |
| | Hiromichi Matsudaira | 10 May 1988 | A |
| Scientific Research Official | Osamu Matsuoka | 1 April 1988 | A |
| Physical Research Department Manager | Katsuhiro Kawajima | 1 April 1988 | A |
| Pharmaco-Chemical Research Department Manager | Mikio Irota | 8 April 1988 | A |
| Chemistry and Pharmacology Research Department Manager | Mikio Irota | 8 April 1988 | M (Pharmaco-Chemical Research Department Manager) |
| Biological Research Department Manager | Hiromichi Matsudaira | 10 May 1988 | P (Director) |
| | Hisami Eto | 10 May 1988 | A |
| Genetics Research Department Manager | Yoshio Tobari | | |
| Physiology and Pathology Research Department Manager | Toshihiko Saba | 1 April 1988 | A |
| Disorders Basic Research Department Manager | Takaharu Ishihara | 31 March 1989 | R |
| Internal Exposure Research Department Manager | Osamu Matsuoka | 1 April 1988 | P (Scientific Research Official) |
| Environmental Sanitation Research Department Manager | Tetsuo Iwakura | | |
| Clinical Research Department Manager | Yukio Tateno | | |
| Disorders Clinical Research Department Manager | Takashi Nakao | 1 September 1988 | R |
| Medical-Use Heavy-Particle Beam Research Department Manager | Yasuo Hirao | | |
| Technology Department Manager | Yasuo Kurosawa | | |
| Training Department Manager | Yoshio Kato | | |
| General Safety Analysis Research Official | Sadayoshi Kobayashi | | |
| Naka-minato Branch Office Director | Yasuyori Ueda | 31 March 1988 | R |
| Environmental Radioecology Research Department Manager | Yoichiro Omomo | | |
| Marine Radioecology Research Department Manager | Takashi Oyanagi | | |

On 8 April 1988 the institute eliminated the Chemistry and Pharmacology Research Department and established the new Pharmaco-Chemical Research Department.

**National Research Center for Disaster Prevention**

| | | | |
|---|---|---|---|
| Director | Hiroshi Takahashi | | |
| Administrative Department Manager | Yoshihisa Shizumori | 31 March 1989 | R |
| 1st Research Section Manager | Takeo Kinoshita | | |
| 2nd Research Section Manager | Ryosuke Hirobe | | |
| 3rd Research Section Manager | Tadao Kabaki | | |
| 4th Research Section Manager | Shigeji Uehara | | |
| Nagaoka Snow and Ice Disaster Prevention Experimental Laboratory Director | Tsutomu Nakamura | | |
| Shinjo Snow and Ice Disaster Prevention Experimental Laboratory Director | Chuji Kimura | | |
| Hiratsuka Marine Disaster Prevention Experimental Laboratory Director | Atsushi Takeda | | |

**National Institute for Research in Inorganic Materials**

| | | |
|---|---|---|
| Director | Nobui Setaka | |
| Administrative Department Manager | Tetsuo Naito | |
| 1st Research Group General Research Official | Nobuhito Shirasaki | |
| 2nd Research Group General Research Official | Toshihiko Ishii | |
| 3rd Research Group General Research Official | Kichisa Inomata | |
| 4th Research Group General Research Official | Shigeo Horiuchi | |
| 5th Research Group General Research Official | Satoshi Okai | |
| 6th Research Group General Research Official | Hikaru Era | |
| 7th Research Group General Research Official | Yoshinori Fujiki | |
| 8th Research Group General Research Official | Yoichiro Sato | |
| 9th Research Group General Research Official | Yorio Makijima | |
| 10th Research Group General Research Official | Masayori Shimazu | |
| 11th Research Group General Research Official | Katsuo Kato | |
| 12th Research Group General Research Official | Yoshio Ishisawa | |
| 13th Research Group General Research Official | Shigeyuki Kimura | |
| 14th Research Group General Research Official | Noboru Oya | |
| 15th Research Group General Research Official | Hiromoto Nakazawa | |
| Super-High Pressure Station General Research Official | Nobui Yamaoka | |
| Super-High Temperature Station General Research Official | Sukeyuki Moriyoshi | |

**National Resources Institute**

| | | | |
|---|---|---|---|
| Director | Tadayoshi Suda | 1 July 1988 | M<br>(Councilor under the Director of the Secretariat) |
| 1st Investigations Group Chief Investigations Official | Tetsuo Kanazawa | 30 June 1988 | L<br>(JAERI) |
| 2nd Investigations Group Chief Investigations Official | Hideyuki Yoshimoto | 8 April 1988 | M<br>(Science and Technology Promotion Bureau, Research and Development Promotion Division, R&D Base Coordination Official) |
| | " | 8 April 1988 | C |
| | " | 30 June 1988 | Combined duties concluded |

| National Resources Institute (Continued) | | | |
|---|---|---|---|
| 3rd Investigations Group Chief Investigations Official | Tomosuke Aoyagi | | |
| 4th Investigations Group Chief Investigations Official | Akijuyotsu Yagizawa | 15 May 1988 | L (Research Development Corp. of Japan) |
| | Mikio Sakaki | 16 May 1988 | C |
| | " | 30 June 1988 | Combined duties concluded |
| 5th Investigations Group Chief Investigations Official | Mitsusuke Hayashi | | |
| 6th Investigations Group Chief Investigations Official | Mikio Sakaki | 30 June 1988 | L (Exhibition Association) |

The National Resources Institute was terminated on 1 July 1988.

| National Institute for Science and Technology Policy | | | |
|---|---|---|---|
| Director | Masahiro Kawasaki | | |
| General Affairs Research Official | Kazuo Suzuki | | |
| 1st Research Group General Chief Research Official | Fujio Niwa | | |
| 1st Research Studies Group Senior Research Official | Akio Hayashi | 1 February 1989 | P (Science and Technology Promotion Bureau, Research and Development Cooperation Division) |
| | Satoru Uehara | 1 February 1989 | A |
| 2nd Research Studies Group Senior Research Official | Hajime Nagahama | | |
| 3rd Research Studies Group Senior Research Official | Fumio Kodama | 1 July 1988 | C |
| 4th Research Studies Group Senior Research Official | Tomosuke Aoyagi | | |

The National Institute for Science and Technology Policy was established on 1 July 1988.

(From the Personnel Division of the Director-General's Secretariat)

## 2. Consultants and Advisors

### Consultants (surnames phonetically ordered)

| | |
|---|---|
| Takeshi Amijima | Advisor to Nippon Electronics Development Co. |
| Hiroshi Ibuka | President of the Japan Institute of Invention and Innovation |
| Naoharu Iwatani | Representative chairman of the board of directors of Iwatani and Co., Ltd. |
| Osamu Ueno | Chairman of the Kansai Economic Federation |
| Jiro Enjoji | Chairman of the Japan Atomic Industrial Forum |
| Satakero Oku | Chairman of the Domestic and Foreign Policy Research Association |
| Hiroharu Kobayashi | Honorary chairman of the board of directors of NEC Corp. |
| Eiyotsuro Saito | Chairman of the Federation of Economic Corporations |
| Makoto Saito | Chairman of the Agriculture, Forestries, and Fisheries Production Technology Council |
| Isamu Saeki | Honorary chairman of the Kinki Nippon Railroad Co. |
| Asaichi Sakaki | Former chairman of Nippon Hoso Kyokai |
| Tatsujiro Shimai | Former chairman of the board of directors of Nippon Nuclear Ship Development Corp. |
| Akikrazo Shitamura | Former administrative vice-minister for science and technology (Period of duty as a consultant: 23 June 1988 to 22 June 1989) |
| Yasuhira Suzue | Former council member of the Council for Science and Technology |

| | |
|---|---|
| Shuzo Hayashi | Former director-general of the Cabinet Legislation Bureau |
| Hokayotsu Hiraiwa | Chairman of the board of directors of Tokyo Electric Power Co., Ltd. |
| Masao Maeda | Chairman of the S&T Promotion Policy Research Study Institute |
| Kagayaki Miyasaki | Chairman of the board of directors of Asahi Chemical Industries Co., Ltd. |
| Tatsuoki Miyajima | To become the director of RIKEN (Period of duty as a consultant: 1 October 1988 to 30 September 1989) |
| Hideji Munekata | Former managing director of JAERI |
| Shigetoshi Yasuda | Former director-general of the Science and Technology Agency |
| Masao Yoshiki | Former member of Space Development Commission |
| Sugao Wadachi | Former director of Nihon Gakushiin |

## Advisors (surnames phonetically ordered)

| | |
|---|---|
| Norio Ikari | Vice president of the Japan Society for the Promotion of Science |
| Toshiaki Ikoma | Professor at the Tokyo University Production Technology Laboratory |
| Michio Ishio | Representative director of the Osaka Science and Technology Center |
| Atsunobu Ichikawa | Professor at the Tokyo Institute of Technology |
| Kazutomo Ito | Member of the NHK Interpretation Committee |
| Masanaga Ito | Chairman of the board of directors of Toray Industries, Inc. |
| Hiroshi Inose | Director of the Science and Technology Information Center |
| Yoshio Iwakura | Honorary professor at Tokyo University |
| Takao Etoru | S&T critic |
| Tairo Oshima | Professor at the Tokyo Institute of Technology Physics Department |
| Yoichi Kaya | Professor at the Tokyo University Engineering Department |
| Toshio Kitagawa | Full-time consultant to Fujitsu Ltd. |
| Mistuyoshi Koizumi | Professor at Ryukoku University |
| Yasutake Kora | Managing director of the Society for the Encouragement of High-Energy Accelerator Research |
| Kazuo Kobayashi | Professor at the Tokyo University Marine Laboratory (Ocean floor structural geology) |
| Shinmu Saito | Director of the Mito Science and Technology Association |
| Masaru Saito | Professor at the Chuo University Economics Department |
| Toshifumi Sakata | Director of the Tokai University Information Technology Center |
| Hiromi Shiikai | Professor at Tsukuba University |
| Ryotatsu Shigihara | Research consultant at the International Research Center |
| Sakae Shimizu | Vice-president of Toshiba Corp. |
| Hajime Shimizu | Representative chairman of the board of directors of Nitto Corp. |
| Akihito Shimoda | Visiting professor at Keio University Physics Department |
| Toshio Sunobe | Lecturer at the Saitama University Physics Department |
| Koichiro Takahashi | Chairman of the Japan Meteoroligical Association |
| Soichiro Takemasa | Chairman of the board of directors of Saitama Newspaper Co. |
| Osamu Taniguchi | Honorary professor at the Tokyo Institute of Technology Engineering Department |
| Toru Teshima | Representative chairman of the board of directors of Stanley Electric Co. |
| Toshiro Toyoda | Managing director of Dentsu Corp. |
| Hiroshi Nakaguchi | Honorary professor at Tokyo University |
| Tochiji Nagase | Representative director of the Chubu Science and Technology Center |
| Sachio Nakamura | Chairman of the Information Science and Technology Association |
| Takanori Hagiwara | Chairman of the Society for the Promotion of Comprehensive Earthquake Prediction Research |
| Keizo Hatta | Honorary professor at Tokyo University |
| Toshiyuki Hirano | Professor at the Tokai University Marine Science Department |
| Noboru Makino | Chairman of the board of directors of Mitsubishi Comprehensive Research Laboratories |

| | |
|---|---|
| Yoshimi Matsui | Professor at Rikkyo University |
| Hiroyuki Maruyama | Professor at the Science University of Tokyo Physics and Engineering Department |
| Takeko Yanase | Freelance journalist |
| Masasumi Yamada | Honorary professor at Tokyo University |
| Yuichi Yamamura | Honorary professor at Osaka University |
| Hiroyuki Yoshikawa | Professor at the Tokyo University Engineering Department |
| Setsuo Yoshida | Chief director of the Radiation Measurement Association |
| Akimitsu Wada | Professor at Tokyo University |
| Toshio Watanuki | Managing director of the Japan Science Film Association |

## Concerning the Science Council of Japan

### 1. Organization of the Science Council of Japan

The Science Council of Japan, a representative organization at home and abroad for Japan's scientists, works towards improving and advancing R&D. It was established within the Prime Minister's Office by the Science Council of Japan Law in January 1949; its objectives are to make its influence of science permeate administration, industry, and the people's lifestyles. Its duties include deliberating important science-related items, working to make those ideas realizable, and making recommendations to the government about policies concerning the development of technology and the promotion of science.

The council's 210 members are divided into 7 special fields (about 30 staff members each). In addition to one chairman and two vice-chairmen, there are sectional assemblies for each of the special fields, a management inquiry commission, a standing committee, a special committee, a research liaison committee, etc.

Currently, at the end of March 1989, the major officers are as follows.

| Officers | | |
|---|---|---|
| Chairman | Jiro Kondo | |
| Vice-chairman | Yasuhiko Oishi | Professor at Rissho University |
| Vice-chairman | Tadashi Watanabe | Honorary professor at Keio University |
| 1st Section (concerning literature and philosophy) | | |
| Section leader | Toshio Kuroda | Professor at Osaka University |
| 2nd Section (concerning law) | | |
| Section leader | Michio Nishihara | Professor at Kobe University |
| 3rd Section (concerning economics) | | |
| Section leader | Yoshiaki Shimabukuro | Professor at Toyo University |
| 4th Section (concerning the physical sciences) | | |
| Section leader | Sadao Nakajime | Professor at Tokai University |
| 5th Section (concerning engineering) | | |
| Section leader | Fusawa Okamura | Professor at the Comprehensive Research Laboratory of Tokyo Denki University |
| 6th Section (concerning agriculture) | | |
| Section leader | Tomoji Egawa | |
| 7th Section (concerning medicine) | | |
| Section leader | Tatsuyoshi Kosaka | Director of Toranomon Hospital |

### 2. Recommendations of the Science Council of Japan, etc.

The Science and Technology Policy Bureau of the Science and Technology Agency is the window through which recommendations to the government are received from the Science Council of Japan. Which ministry or agency will process the recommendations is decided in liaison meetings of concerned ministries and agencies.

(From the Planning Office of the Policy Division of the Science and Technology Policy Bureau.)

## The Science and Technology Agency's Library

As the S&T administration library, this library gives priority to collecting publications concerning S&T in general; as a branch of the National Diet Library and as a member of the Federation of Specialized Libraries, it conducts library activities in coordinated cooperation with all other libraries.

**Table 7. Current State of the Science and Technology Agency's Library**

| Classification | Accumulated number of books | Number of additional books this year | Foreign magazines | Japanese magazines | Special materials | Number of full-time employees |
|---|---|---|---|---|---|---|
| | Books | Books | Titles | Titles | Items | People |
| Science and Technology Agency's Library | 41,832 | 1,393 | 71 | 422 | 672 | 2 |
| Science and Technology Agency's Atomic Energy Room | 2,158 | 19 | 11 | 13 | - | - |
| National Aerospace Laboratory Branch | 40,366 | 1,169 | 313 | 416 | 73,860 | 3 |
| National Research Institute for Metals Branch | 31,662 | 820 | 340 | 749 | - | 2 |
| National Institute of Radiological Sciences Branch | 42,608 | 1,612 | 354 | 146 | - | 4 |

Currently, at the end of March 1989 (From the Information Systems Division of the National Institute for Science and Technology Policy)

## Summary of Public Corporations under the Jurisdiction of the Science and Technology Agency

31 March 1989 From the Policy Division of the Science and Technology Policy Bureau of the Science and Technology Agency

| Organization Name | Date Established | Representative | Telephone Number |
|---|---|---|---|
| 1 Arai Science and Technology Promotion Foundation | 12 August 1985 | Yoji Arai, managing director | 03 (632) 8381 |
| 2 Izumi Science and Technology Promotion Foundation | 15 December 1988 | Masao Izumi, managing director | 06 (375) 7227 |
| 3 Iketani Science and Technology Promotion Foundation | 28 February 1989 | Taro Iketani, managing director | 03 (580) 1712 |
| 4 Inamori Foundation | 12 April 1984 | Ryuzo Seshima, chairman | 075 (255)2688 |
| 5 Naoji Iwatani Memorial Foundation | 21 November 1973 | Daisuke Nishiyama, managing director | 03 (580) 2251 |
| 6 Center for the Promotion of Space-Environment Utilization | 22 February 1987 | Hiroji Kobayashi, chairman | 03 (5273) 2441 |
| 7 Kazuchika Okura Memorial Foundation | 25 March 1970 | Shuji Kogawa, managing director | 03 (580) 7339 |
| 8 Okawachi Memorial Society | 6 February 1958 | Tatsuoki Miyajima, managing director | 03 (501) 2856 |
| 9 Osaka Science and Technology Center | 30 August 1967 | Takamitsu Iida, chairman | 06 (443) 5321 |
| 10 Osaka Technology Promotion Association | 19 March 1965 | Masao Kitamura, managing director | 06 (443) 5321 |
| 11 Osaka Bioscience Research Institute | 28 January 1987 | Keizo Saji, managing director | 06 (872) 4812 |
| 12 Ogasawara Science and Technology Promotion Foundation | 12 September 1987 | Toshiaki Ogasawara, managing director | 03 (434) 9456 |
| 13 Undersea Development Technology Association | 8 November 1968 | Kiyoshi Kono, chairman | 03 (813) 8511 |
| 14 Marine City Development Research Society | 10 December 1987 | Takeshi Yamashita, chairman | 03 (264) 2201 |

| Organization Name | Date Established | Representative | Telephone Number |
|---|---|---|---|
| 15 Science and Technology Public Relations Foundation | 7 July 1973 | Eiji Munekata, chairman | 03 (5695) 1471 |
| 16 Society for Science and Technology and Economics | 20 January 1967 | Hiroji Kobayashi, chairman | 03 (263) 5501 |
| 17 Chemical Information Association | 8 July 1975 | Takashi Mukaibo, chairman | 03 (816) 3462 |
| 18 Nuclear Substance Management Center | 15 April 1972 | Eiji Suzuki, chairman | 03 (593) 2551 |
| 19 Kato Memorial Bioscience Research Foundation | 23 December 1988 | Mikio Kato, managing director | 0427 (25) 2555 |
| 20 Kinki Chemistry Association | 20 January 1984 | Saburo Ishikawa, chairman | 06 (441) 5531 |
| 21 Kinki Regional Invention Center | 27 December 1960 | Chozaburo Matsuda, managing director | 075 (771) 6117 |
| 22 Gunma Regional Invention Center | 20 September 1962 | Yoshitaka Osawa, managing director | 0277 (54) 9051 |
| 23 Center for Nuclear Power Safety Technology | 1 June 1964 | Kunimitsu Umezawa, managing director | 03 (814) 7481 |
| 24 Center for Nuclear Power Safety Research | 1 June 1964 | Eizo Tajima, managing director | 03 (503) 5785 |
| 25 Center for Nuclear Power Environmental Maintenance | 27 October 1976 | Toshio Fukuda, managing director | 03 (504) 1081 |
| 26 Nuclear Power Benefit Association | 28 May 1969 | Arinaga Taniguchi, managing director | 0292 (82) 5061 |
| 27 Nuclear Power Facilities Decommissioning Research Association | 27 December 1988 | Hiroshi Murata, managing director | 0292 (83) 3010 |
| 28 Nuclear Power Data Center | 1 August 1981 | Ichiro Miyanaga, managing director | 0292 (82) 5017 |
| 29 International Marine Science And Technology Association | 31 September 1987 | Hajime Sako, chairman | 03 (667) 5350 |
| 30 International Science and Technology Foundation | 1 November 1982 | Kisaburo Yokota, managing director | 03 (508) 7691 |
| 31 Domestic Production Technology Promotion Society | 29 September 1967 | Toshihiko Kubo, managing director | 03 (212) 2662 |
| 32 Materials Science and Technology Promotion Foundation | 1 August 1984 | Teiichi Yamazaki, managing director | 03 (482) 2522 |
| 33 Sagobo Institute | 11 March 1988 | Saburo Higashi, chairman | 03 (222) 0747 |
| 34 Resources Association | 10 November 1954 | Yoshimitsu Takeyasu, chairman | 03 (454) 2581 |
| 35 Resources-Exploration-Use Observational Systems R&D Organization | 21 November 1986 | Nihachiro Katayama, managing director | 03 (459) 1657 |
| 36 Society for the Promotion of Comprehensive Research in Earthquake Prediction | 22 January 1981 | Takahiro Hagiwara, chairman | 03 (292) 1966 |
| 37 Center for Sight and Hearing Science and Technology | 4 May 1969 | Shigeyoshi Matsumae, managing director | 03 (203) 4121 |
| 38 Shimadzu Science and Technology Promotion Foundation | 10 June 1980 | Michio Okamoto, managing director | 075 (251) 2812 |
| 39 Shorai Science and Technology Promotion Foundation | 1 March 1983 | Nobuichi Ishino, managing director | 06 (229) 0966 |
| 40 Information Science and Technology Association | 18 May 1961 | Yukio Nakamura, chairman | 03 (813) 3791 |
| 41 Research Development Corporation of Japan | 12 December 1968 | Hiroyoshi Miyashima, chairman | 03 (775) 2021 |

| Organization Name | Date Established | Representative | Telephone Number |
|---|---|---|---|
| 42 Watanabe Memorial Society for the Promotion of New Technology | 1 July 1982 | Yoshimitsu Takeyasu, managing director | 03 (490) 6780 |
| 43 Suga Weathering Technology Promotion Foundation | 10 December 1981 | Choichi Suga, managing director | 03 (354) 5248 |
| 44 Survival Science Research Institute | 22 March 1984 | Hiroshi Kumagaya, managing director | 03 (563) 3518 |
| 45 Society for the Promotion of the Life Sciences | 26 April 1973 | Hidetoshi Matsuoka, managing director | 06 (394) 1050 |
| 46 Secom Science and Technology Promotion Foundation | 20 March 1979 | Shigemori Fukawa, managing director | 03 (346) 2587 |
| 47 National Association of Inventive Women | 30 March 1970 | Mutsuko Miki, chairman | 03 (403) 1918 |
| 48 Comprehensive Safety Engineering Research Institute | 15 August 1973 | Tsuyoshi Hikata, managing director | 03 (574) 7826 |
| 49 Takayanagi Memorial Foundation for the Promotion of Electronics Science and Technology | 31 October 1984 | Kenjiro Takayanagi | 03 (468) 2903 |
| 50 Chubu Science and Technology Center | 30 August 1967 | Kazuo Nagasawa, chairman | 052 (231) 3043 |
| 51 Tsukuba Science Exposition Memorial Foundation | 28 March 1987 | Nihachiro Hanamura, chairman | 0298 (58) 1100 |
| 52 Low-Temperature Engineering Association | 30 March 1966 | Yoshihito Oshima, chairman | 03 (818) 4539 |
| 53 Terumo Science and Technology Promotion Foundation | 24 April 1987 | Mitsuo Tozawa, managing director | 03 (375) 5124 |
| 54 Society for the Encouragement of Electricity Science and Technology | 17 April 1962 | Noboru Takagi, chairman | 03 (233) 0695 |
| 55 Toa Science and Technology Cooperation Association | 12 November 1981 | Masao Maeda, managing director | 03 (444) 7461 |
| 56 Tokyo Ohka Science and Technology Promotion Foundation | 29 May 1987 | Kenichi Honda, managing director | 044 (733) 8006 |
| 57 Toyobo Hundred-Year Memorial Biotechnology Research Foundation | 9 April 1982 | Osamu Ueno, managing director | 03 (660) 4890 |
| 58 Toray Science and Technology Promotion Society | 23 June 1960 | Masayoshi Ito, managing director | 0473 (50) 6103 |
| 59 Tokuyama Science and Technology Promotion Foundation | 19 September 1988 | Yasuji Onoe, managing director | 03 (597) 5124 |
| 60 Nichigaku Memorial Science and Technology Promotion Foundation | 12 September 1987 | Tomio Furuta, managing director | 03 (798) 2056 |
| 61 Japan-China Scientific and Technological Culture Center | 26 January 1982 | Junichi Nishizawa, chairman | 03 (295) 0411 |
| 62 Japan Isotope Association | 1 May 1954 | Yuichi Yamamura, chairman | 03 (946) 7111 |
| 63 Japan Space Youths Group | 21 November 1986 | Kimio Fukushima, managing director | 03 (503) 8290 |
| 64 Japan Applied Oxygen Association | 13 May 1964 | Keitaro Adachi, chairman | 06 (300) 2669 |
| 65 Japan Scientific Film Association | 30 November 1967 | Toyo Hiraiwa, chairman | 03 (591) 1033 |
| 66 Japan Science Foundation | 15 April 1960 | Eishiro Sato, chairman | 03 (212) 8471 |
| 67 Nippon Science and Technology Federation | 5 April 1962 | Yasuhira Suzue, managing director | 03 (5379) 1230 |

| Organization Name | Date Established | Representative | Telephone Number |
|---|---|---|---|
| 68 Japan Society of Consulting Engineers | 10 March 1959 | Minoru Ueda, chairman | 03 (591) 5141 |
| 69 Japan Atomic Industrial Forum | 1 March 1956 | Jiro Enjoji, chairman | 03 (508) 2411 |
| 70 Japan Atomic Energy Relations Organization | 1 April 1969 | Hiroshi Murata, managing director | 03 (504) 1381 |
| 71 Japan Transportation Science Assembly | 23 February 1965 | Wakatsu Nishikawa, chairman | 03 (264) 5481 |
| 72 Japan Consulting Engineers Association | 1 August 1977 | Tatsuo Hori, chairman | 03 (591) 3208 |
| 73 Japan Geothermal Survey Society | 6 September 1961 | Tatsuo Kawai, managing director | 03 (212) 7885 |
| 74 Japan Invention Promotion Association | 11 November 1959 | Takashi Fukuda, chairman | 03 (464) 6992 |
| 75 Japan Analysis Center | 1 May 1974 | Hiroshi Hamaguchi, managing director | 0434 (23) 5325 |
| 76 New Technology Promotion Foundation | 24 December 1986 | Kiyoji Fujii, chairman | 03 (504) 1323 |
| 77 Tropical Marine Ecology Research Promotion Foundation | 6 October 1988 | Saburo Hosaka, managing director | 03 (490) 7266 |
| 78 Capacity Development Engineering Center | 7 September 1968 | Yasuhira Suzue, chairman | 0424 (73) 1261 |
| 79 Invention Society | 28 April 1972 | Toyokazu Toyozawa, chairman | 03 (371) 8811 |
| 80 Invention Association | 27 December 1964 | Futoshi Ibuka, chairman | 03 (502) 0511 |
| 81 Optical Science and Technology Promotion Foundation | 23 December 1988 | Daisaku Miwa, managing director | 0534 (54) 0598 |
| 82 Hidaka Marine Science Promotion Foundation | 8 March 1971 | Yoshimitsu Morita, managing director | 03 (486) 8393 |
| 83 Corrosion Protection Association | 28 April 1977 | Masakazu Nagayama, chairman | 03 (844) 3553 |
| 84 Fujihara Science Foundation | 1 May 1959 | Fumio Tanaka, managing director | 03 (561) 7736 |
| 85 Women's Invention Association | 21 April 1970 | Hironori Shimojo, chairman | 03 (255) 1544 |
| 86 Radiation Effects Association | 14 September 1960 | Satoshi Kumatori, managing director | 0472 (51) 2111 |
| 87 Radiation Measurement Association | 1 October 1980 | Tokinari Yoshida, managing director | 0292 (82) 5546 |
| 88 Radiation Exposure Promotion Association | 12 June 1968 | Noboru Amano, managing director | 0292 (82) 9533 |
| 89 Matsuda Foundation | 26 October 1984 | Noriaki Furuta, managing director | 082 (285) 4611 |
| 90 Mifumi Science and Technology Association | 23 July 1973 | Kaheiji Okazaki, managing director | 03 (503) 4681 |
| 91 Mirai Engineering Research Institute | 15 February 1971 | Shigeru Yonezawa, managing director | 03 (215) 1911 |
| 92 Yazaki Science and Technology Promotion Memorial Foundation | 15 December 1982 | Kunio Kanemitsu, managing director | 03 (455) 8878 |
| 93 Yoshida Science and Technology Foundation | 26 February 1975 | Kunimitsu Umezawa, managing director | 03 (262) 4916 |
| 94 Life Sciences Promotion Foundation | 12 December 1983 | Kunimitsu Umezawa, managing director | 03 (263) 2641 |
| 95 Life Sciences Research Institute | 3 June 1983 | Jiro Kondo, managing director | 03 (241) 1878 |

| Organization Name | Date Established | Representative | Telephone Number |
|---|---|---|---|
| 96 Research Management Technology Dissemination Association | 1 June 1983 | Takashi Mukaibo, chairman | 03 (407) 9729 |
| 97 Remote Sensing Technology Center | 28 July 1975 | Yasuhira Suzue, managing director | 03 (403) 1761 |
| 98 Laser Technology Comprehensive Research Institute | 31 October 1987 | Takamitsu Iida, managing director | 06 (443) 5321 |

## Abbreviated Chronological Table of the Science and Technology Agency (past three years)

| | |
|---|---|
| **FY 1986** | |
| 12 February | NASDA, decision to launch the "Yuri 2-b" broadcast satellite |
| 28 March | "Science and Technology Policy Outline" Cabinet decision |
| 20 May | Research Exchange Promotion Act established (put into effect on 19 November) |
| 27 May | Nuclear Reactor Regulatory Law partially revised (put into effect on 26 November) |
| 1 July | Internal department reorganization (Science and Technology Policy Bureau, Science and Technology Promotion Bureau, and the Research and Development Bureau established) |
| 13 August | NASDA launches the No 1 experimental unit of an H-I rocket |
| **FY 1987** | |
| 19 February | NASDA launches the "Momo 1" No 1 marine observation satellite |
| 6 March | Signing of the "Treaty on the Early Reporting of Nuclear Accidents" and the "Treaty on Assistance in case of a Nuclear Accident or Emergency Radiation Situation" |
| 8 - 10 June | At the Venice Summit, the Human Frontier Program is incorporated into economic statements |
| 27 August | NASDA launches the "Kiku 5" type-V engineering test satellite from an H-I rocket |
| **FY 1988** | |
| 19 February | NASDA launches the "Sakura 3-a" communications satellite from an H-I rocket |
| 20 May | Nuclear Reactor Regulatory Law partially revised (officially announced on 27 May) |
| 21 June | Japan-U.S. Science and Technology Cooperation Agreement signed at the Toronto Summit |
| 1 July | National Institute for Science and Technology Policy established (National Resources Institute terminated) |
| **FY 1989** | |
| 27 January | NASDA launches the TR-I-2 |
| 31 March | Law on Compensation for Nuclear Power Damages partially revised |

## Chronological List of Science and Technology Agency Director-Generals

| Director-General | Period of Service | Additional Post or Special Assumption of Post |
|---|---|---|
| Shoriki Matsutaro | 19 May 1956 - 31 December 1956 | |
| Kiyomi Ishibashi | 31 December 1956 - 31 December 1956 | Special Assumption of Post (Prime Minister) |
| Koichi Ueda | 31 December 1956 - 25 February 1957 | Additional post (Director-General of the Economic Planning Agency) |
| Koichi Ueda | 25 February 1957 - 10 July 1957 | Additional post (Director-General of the Economic Planning Agency) |
| Shoriki Matsutaro | 10 July 1957 - 12 June 1958 | Additional post (chairman of the National Public Safety Commission) |
| Takeo Miki | 12 June 1958 - 31 December 1958 | Additional post (Director-General of the Economic Planning Agency) |
| Tatsunosuke Takazaki | 31 December 1958 - 12 January 1959 | Additional post (Minister of International Trade and Industry) |
| Tatsunosuke Takazaki | 12 January 1959 - 18 June 1959 | Additional post (Minister of International Trade and Industry) |
| Yasuhiro Nakasone | 18 June 1959 - 19 July 1960 | |
| Kazuikio Araki | 19 July 1960 - 8 December 1960 | Additional post (Minister of Education) |
| Masanosuke Ikeda | 8 December 1960 - 18 July 1961 | Special Assumption of Post (Prime Minister) |
| Takeo Miki | 18 July 1961 - 18 July 1962 | |

## Chronological List of Science and Technology Agency Director-Generals (Continued)

| Director-General | Period of Service | Additional Post or Special Assumption of Post |
|---|---|---|
| Tsurotoshi Kondo | 18 July 1962 - 18 July 1963 | |
| Eisaku Sato | 18 July 1963 - 9 December 1963 | Additional posts (in charge of the Olympics, Director-General of the Hokkaido Development Agency) |
| Eisaku Sato | 9 December 1963 - 29 June 1964 | Additional posts (in charge of the Olympics, Director-General of the Hokkaido Development Agency) |
| Hayato Ikeda | 29 June 1964 - 18 July 1964 | |
| Hakaruichi Aichi | 18 July 1964 - 9 November 1964 | Additional post (Minister of Education) |
| Hakaruichi Aichi | 9 November 1964 - 3 June 1965 | |
| Shokichi Uehara | 3 June 1965 - 1 August 1966 | |
| Yoshikazu Arita | 1 August 1966 - 3 December 1966 | Additional post (Minister of Education) |
| Susumu Nikaido | 3 December 1966 - 17 February 1967 | Additional post (Director-General of the Hokkaido Development Agency) |
| Susumu Nikaido | 17 February 1967 - 25 November 1967 | Additional post (Director-General of the Hokkaido Development Agency) |
| Naotsugi Nabeshima | 25 November 1967 - 30 November 1968 | |
| Shiro Kiuchi | 30 November 1968 - 14 January 1970 | |
| Nobuichi Nishida | 14 January 1970 - 5 July 1971 | Additional post (Director-General of the Hokkaido Development Agency) |
| Wataru Hiraizumi | 5 July 1971 - 16 November 1971 | |
| Shiro Kiuchi | 16 November 1971 - 7 July 1972 | |
| Yasuhiro Nakasone | 7 July 1972 - 22 December 1972 | Additional post (Minister of International Trade and Industry) |
| Katsuo Maeda | 22 December 1972 - 25 November 1973 | |
| Yoshiari Moriyama | 25 November 1973 - 11 November 1974 | |
| Atsuro Adachi | 11 November 1974 - 9 December 1974 | |
| Yoshitake Sasaki | 9 December 1974 - 15 September 1976 | |
| Masao Maeda | 15 September 1976 - 24 December 1976 | |
| Munesuke Ueno | 24 December 1976 - 28 November 1977 | |
| Taisaburo Kumagaya | 28 November 1977 - 7 December 1978 | |
| Iwamitsu Kaneko | 7 December 1978 - 9 November 1979 | |
| Hiroji Nagata | 9 November 1979 - 17 July 1980 | |
| Ichiro Nakagawa | 17 July 1980 - 30 November 1981 | Additional post (in charge of the international science exposition) |
| Ichiro Nakagawa | 30 November 1981 - 27 November 1982 | " |
| Takamitsu Anda | 27 November 1982 - 27 December 1983 | " |
| Michiyuki Iwarugi | 27 December 1983 - 1 November 1984 | " |
| Reichi Takeuchi | 1 November 1984 - 28 December 1984 | " |
| Kiyohira Kawano | 28 December 1984 - 22 July 1986 | " |
| Yataro Mitsumoto | 22 July 1986 - 11 June 1987 | |
| Muneichiro Ito | 11 June 1987 - 27 December 1988 | |
| Shigeichi Miyazaki | 27 December 1988 - | |

## Chronological List of Parliamentary Vice-Ministers for Science and Technology

| Name | Period of Service |
|---|---|
| Kenzo Sato | 19 May 1956 - 23 December 1956 |
| Daisuke Arita | 23 December 1956 - 25 February 1957 |
| Daisuke Arita | 25 February 1957 - 16 July 1957 |
| Manji Yoshida | 16 July 1957 - 12 June 1958 |
| Katsura Ishii | 17 June 1958 - 30 June 1959 |
| Fuku Yokoyama | 30 June 1959 - 19 July 1960 |
| Tonosuke Otani | 22 July 1960 - 8 December 1960 |
| Ichiro Matsumoto | 9 December 1960 - 25 July 1961 |
| Toshihogi Yamamoto | 25 July 1961 - 27 July 1962 |
| Tsuneo Uchida | 27 July 1962 - 30 July 1963 |
| Toshio Kashima | 30 July 1963 - 9 December 1963 |
| Toshio Kashima | 10 December 1963 - 24 July 1964 |
| Yoshiro Kikuike | 24 July 1964 - 9 November 1964 |
| Yazo Koketsu | 13 November 1964 - 8 June 1965 |
| Yoshikazu Tagawa | 8 June 1965 - 2 August 1966 |
| Yoshira Shiseki | 2 August 1966 - 17 February 1967 |
| Yoshira Shiseki | 17 February 1967 - 28 November 1967 |
| Mitsuteru Amano | 28 November 1967 - 3 December 1968 |
| Wataru Hiraizumi | 3 December 1968 - 14 January 1970 |
| Takao Fujimoto | 20 January 1970 - 9 July 1971 |
| Hide Awayama | 9 July 1971 - 7 July 1972 |
| Takao Fujinami | 12 July 1972 - 22 December 1972 |
| Muneichi Ito | 26 December 1972 - 27 November 1973 |
| Shigeru Nagaya | 27 November 1973 - 12 July 1974 |
| Teiji Nakamura | 12 July 1974 - 15 November 1974 |
| Masahide Katayama | 15 November 1974 - 9 December 1974 |
| Masahide Katayama | 12 December 1974 - 26 December 1975 |
| Ichiro Ozawa | 26 December 1975 - 20 September 1976 |
| Noboru Yano | 20 September 1976 - 24 December 1976 |
| Noboru Yano | 24 December 1976 - 29 July 1977 |
| Tomoji Oshima | 29 July 1977 - 28 November 1977 |
| Masahisa Kamijo | 30 November 1977 - 7 December 1978 |
| Susumu Hanyuda | 8 December 1978 - 9 November 1979 |
| Tadao Natsume | 13 November 1979 - 18 July 1980 |
| Takatomo Takahira | 18 July 1980 - 2 December 1981 |
| Tomiko Hayashi | 2 December 1981 - 27 November 1982 |
| Jiro Iwagami | 30 November 1982 - 27 December 1983 |
| Saburo Okabe | 27 December 1983 - 2 November 1984 |
| Ken Naito | 2 November 1984 - 28 December 1985 |
| Eizoro Maejima | 28 December 1985 - 22 July 1986 |
| Tetsuro Shimura | 23 July 1986 - 6 November 1987 |
| Hiroshi Takeyama | 10 November 1987 - 28 December 1988 |
| Yoshi Yoshikawa | 28 December 1988 - |

**Chronological List of Administrative Vice-Ministers for Science and Technology**

| Name | Period of Service |
|---|---|
| Noboru Shinohara | 19 May 1956 - 26 May 1961 |
| Yasuhira Suzue | 26 May 1961 - 17 January 1964 |
| Taro Hisata | 17 January 1964 - 20 November 1964 |
| Keijiro Inoue | 20 November 1964 - 22 November 1968 |
| Tsuneo Fujinami | 22 November 1968 - 22 June 1971 |
| Kunio Umezawa | 22 June 1971 - 20 July 1973 |
| Yoshimitsu Takeyasu | 20 July 1973 - 20 March 1975 |
| Akinari Kurachi | 20 March 1975 - 1 July 1977 |
| Yoshinori Ihara | 1 July 1977 - 3 July 1979 |
| Hiroyuki Ozawa | 3 July 1979 - 16 January 1981 |
| Masanori Yamano | 16 January 1981 - 21 June 1983 |
| Takao Ishiwatari | 21 June 1983 - 5 October 1984 |
| Akizo Shimamura | 5 October 1984 - 23 June 1987 |
| Toshio Uchida | 23 June 1987 - |

Foreign Broadcast Information Service (FBIS) and Joint Publications Research Service (JPRS) publications contain political, military, economic, environmental, and sociological news, commentary, and other information, as well as scientific and technical data and reports. All information has been obtained from foreign radio and television broadcasts, news agency transmissions, newspapers, books, and periodicals. Items generally are processed from the first or best available sources. It should not be inferred that they have been disseminated only in the medium, in the language, or to the area indicated. Items from foreign language sources are translated; those from English-language sources are transcribed. Except for excluding certain diacritics, FBIS renders personal and place-names in accordance with the romanization systems approved for U.S. Government publications by the U.S. Board of Geographic Names.

Headlines, editorial reports, and material enclosed in brackets [ ] are supplied by FBIS/JPRS. Processing indicators such as [Text] or [Excerpts] in the first line of each item indicate how the information was processed from the original. Unfamiliar names rendered phonetically are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear from the original source but have been supplied as appropriate to the context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by the source. Passages in boldface or italics are as published.

## SUBSCRIPTION/PROCUREMENT INFORMATION

The FBIS DAILY REPORT contains current news and information and is published Monday through Friday in eight volumes: China, East Europe, Soviet Union, East Asia, Near East & South Asia, Sub-Saharan Africa, Latin America, and West Europe. Supplements to the DAILY REPORTs may also be available periodically and will be distributed to regular DAILY REPORT subscribers. JPRS publications, which include approximately 50 regional, worldwide, and topical reports, generally contain less time-sensitive information and are published periodically.

Current DAILY REPORTs and JPRS publications are listed in *Government Reports Announcements* issued semimonthly by the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161 and the *Monthly Catalog of U.S. Government Publications* issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

The public may subscribe to either hardcover or microfiche versions of the DAILY REPORTs and JPRS publications through NTIS at the above address or by calling (703) 487-4630. Subscription rates will be provided by NTIS upon request. Subscriptions are available outside the United States from NTIS or appointed foreign dealers. New subscribers should expect a 30-day delay in receipt of the first issue.

U.S. Government offices may obtain subscriptions to the DAILY REPORTs or JPRS publications (hardcover or microfiche) at no charge through their sponsoring organizations. For additional information or assistance, call FBIS, (202) 338-6735,or write to P.O. Box 2604, Washington, D.C. 20013. Department of Defense consumers are required to submit requests through appropriate command validation channels to DIA, RTS-2C, Washington, D.C. 20301. (Telephone: (202) 373-3771, Autovon: 243-3771.)

Back issues or single copies of the DAILY REPORTs and JPRS publications are not available. Both the DAILY REPORTs and the JPRS publications are on file for public reference at the Library of Congress and at many Federal Depository Libraries. Reference copies may also be seen at many public and university libraries throughout the United States.